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Scientific and Technical Aerospace Reports

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October 8, 1965

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-30399*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECT OF SIMULATED ABLATION-GAS INJECTION ON THE SHOCK LAYER OF BLUNT BODIES AT MACH NUMBERS OF 3 AND 5
George E. Kaattari Washington, NASA, Aug. 1965 16 p refs (NASA-TN-D-2954) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The effect of simulated ablation of gases on the bow shock layer of spherical-segment-face and flat-face models was investigated experimentally. Ablation was simulated by injecting the gases air, helium, and Freon through the porous front faces of these models into an oncoming air stream for which the free-stream Mach numbers were 3 and 5. Shadowgraph pictures taken during the test usually showed the presence of an interface separating the injected gas and the oncoming air stream. In most cases the bow shock standoff distance increased linearly with the ratio of injected-gas to free-stream mass flow. However, in some cases, large, unstable fluctuations in bow shock standoff distances occurred at large mass-flow ratios. Except when the flow was unstable, the test results at a given Mach number for the different gases correlated with the flow rate of the gas divided by the square root of its molecular weight. The effect of Mach number could be accounted for by including in the correlation parameter the square root of the normal-shock density ratio. The experimental bow shock standoff distances for the spherical-segment-face models were found to be in fair accord with theoretical results. Author

N65-30501# David Taylor Model Basin, Washington, D. C.
WIND TUNNEL INVESTIGATION OF MODEL M3A-2 AERIAL CONTAINER Test Report
Edward F. Kuklewicz Jul. 1965 37 p ref
(DTMB-AL-18; AD-467045)

A study was conducted in the David Taylor Model Basin 7- by 10-Foot Transonic Wind Tunnel to evaluate the pressure field around an M3A-2 Aerial Container model suspended on an A-4B aircraft model. Pressure measurements were made to determine a position on the container having a minimum static pressure error. Data were obtained at constant sideslip angles of $-5°$, $0°$, and $5°$ through an angle-of-attack range of $-4°$ to $14.5°$. Mach numbers ranged from 0.7 to 0.95 at Reynolds numbers from 1.75×10^6 to 1.94×10^6 per foot. An empirical equation is developed for determining pressure altitude from experimental values of pressure coefficients taken at a critical orifice on the body. Author

N65-30570# Aeronautical Research Council (Gt. Brit.)
MEASUREMENTS OF ZERO-LIFT DRAG AT SUPERSONIC SPEEDS FOR A SYMMETRICAL SLENDER WING MODEL WITH DIFFERENT ROUGHNESS BANDS
E. C. Carter May 1963 31 p refs Supersedes ARC-24838 (ARC-CP-741; ARC-24838) HMSO: 6s

This paper gives the results of tests in the A.R.A. 30" x 27" Supersonic Tunnel on a slender ogee wing (p = 0-45) to determine the drag at zero lift for the model fitted with various alternative roughness bands. Tests were made at Mach numbers from M = 1·6 to M = 2·4 over a wide range of Reynolds number from about $R = 2 \cdot \times 10^6$ to $R = 7 \times 10^6$, based on the wing root chord of 2 ft. The evidence from these tests is not sufficient to define quantitatively the roughness application that should be used for other slender-wing models. On the other hand, the experience is sufficient to recommend a procedure for choosing an optimum roughness band that will be both effective in fixing transition and will give the smallest possible drag penalty. This procedure will involve some preliminary testing on any new model. Author

N65-30654# Cambridge Univ. (England). Engineering Lab.
BENDING FLUTTER OF UNSTALLED CASCADE BLADES AT FINITE DEFLECTION
D. S. Whitehead London, Min. of Aviation, 1965 36 p refs Supersedes ARC-24059
(ARC-R&M-3386) HMSO: 15s 6d

This report gives a method of calculating the conditions under which a cascade of unstalled blades will flutter in their bending mode. The blades are assumed to be flat plates and the flow is assumed to be two-dimensional. It is found that, when there is deflection of the steady flow through the cascade, bending flutter can occur in which there is a phase difference between the motion of one blade and its neighbours. The flutter boundaries for a range of cascades have been calculated on a digital computer and are presented. For turbine cascades these boundaries are not far from typical operating conditions in gas turbines and this may be why blades in the low pressure end of steam turbines have been found to require lacing wires. Comparisons are made with earlier theories due to Sohngen and Shioiri. Author

N65-30712# National Research Council of Canada, Ottawa (Ontario).
LIFTING SURFACE THEORY FOR WINGS WITH JET FLAPS
A. Das 1964 50 p refs Transl. into ENGLISH from JaHR. 1960 Wiss. Ges. Luftfahrt (Berlin), no. 112–133
(NRC-TT-1122)

This paper presents an approximation method for calculating the lift and pitching moment distribution of wings of arbitrary shape and arbitrary distribution of the jet phenomena. For the basic distribution of the vortex density along the wing chord and over the jet, the basis taken is the two dimensional vortex distribution of a previous author. The method of calculation was developed on the basis of the lifting surface theory. A summarizing presentation of lifting surface theory is also given. N.E.A.

N65-30775*# McDonnell Aircraft Corp., St. Louis, Mo.
FLUCTUATING PRESSURE DATA 32% MERCURY-ATLAS CONFIGURATION
Robert E. Davis 30 Apr. 1965 113 p refs
(Contract NAS1-3179)
(NASA-CR-66004; B661) CFSTI: HC $4.00/MF $0.75 CSCL 01A

Fluctuating pressure data which have been reduced from magnetic tape recordings from transonic wind tunnel tests of Mercury-Atlas configurations are presented. Raw data consist of individual time histories of pressure from transducers in the model; reduced data, from selected pairs of time histories, consist of normalized auto correlation of each signal and cross correlation between two signals, power spectral density of each signal and cross correlation between two signals, power spectral density of each signal, normalized co- and quad-spectral densities between two signals, and modulus and phase coherency between two signals. Reduction data techniques are discussed. All spectral data are presented for model, prototype, and reduced frequencies, and an index of plots and tabulations by Mach number and transducer pairs is presented for each of the configurations. M.W.R.

N65-30830# ARO, Inc., Arnold Air Force Station, Tenn.
AN INVESTIGATION OF THE EFFECTS OF SHOCK IMPINGEMENT ON A BLUNT LEADING EDGE
A. D. Ray and R. L. Palko Jul. 1965 21 p refs
(Contract AF 4D(600)-1000)
(AEDC-TR-65-153; AD-466166)

Tests were conducted at hypersonic Mach numbers on a blunt leading edge model both with and without an impinging shock. The effects of Reynolds number, Mach number, leading edge sweep angle, and impinging shock strength on the temperature and pressure distribution for the leading edge were determined. The tests were conducted at nominal Mach numbers of 6, 8, and 10 at unit Reynolds numbers of 0.58×10^6 to 3.55×10^6 per foot with a sweep angle range of 0 to 75 deg. Selected results which show the effect of shock generator angle and sweep angle at Mach 6 and 10 are presented. Author

N65-30858# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THEORETICAL AND EXPERIMENTAL STUDIES OF AIRFOIL CHARACTERISTICS IN NONUNIFORMED SHEARED FLOW Technical Report, Jun. 1963–Aug. 1964
W. G. Brady Fort Eustis, Va., Army Aviation Mater. Labs., May 1965 91 p refs
(Contract DA-44-177-AMC-70(T))
(CAL-AF-1841-S-1; USAAML-TR-65-17; AD-616617)

The results of a continuing theoretical and experimental investigation of airfoil characteristics in nonuniform sheared flows are presented. The theoretical investigation was concerned with attempts to determine the cause of anomalous maximum lift behavior of airfoils in two-dimensional nonuniform sheared flows. A wing spanning the wind-tunnel test section and partially immersed in an axisymmetric nonuniform sheared flow jet representative of a propeller slipstream was investigated in the experimental program. It was determined that separation characteristics of airfoil sections inside and outside the jet were quite different. Although section aerodynamic characteristics varied spanwise along the wing with differing vertical positions relative to the jet, there appeared to be no vertical position of the wing at which significantly more lift was generated on sections inside the slipstream at any angle of attack below complete separation. Author

N65-30955*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE PRESSURE DISTRIBUTION AND FLOW FIELDS OF BLUNTED CONES AT HYPERSONIC MACH NUMBERS
Joseph W. Cleary Washington, NASA, Aug. 1965 77 p refs
(NASA-TN-D-2969) CFSTI: HC $3.00/MF $0.75 CSCL 01A

An experimental and theoretical investigation of the flow of a perfect gas over spherically blunted cones has been conducted at hypersonic Mach numbers. Numerical solutions for inviscid flow at zero angle of attack are presented and analyzed to show the effect of code angle on surface-pressure distribution for Mach numbers of 10 and ∞ and specific-heat ratios of 1.4 and 1.667. Profiles of the inviscid shock-layer flow properties for a 15° half-angle blunted cone are given at several axial stations. Experimental longitudinal and circumferential pressure distributions for 15° and 30° half-angle blunted cones with bluntness ratios of 6 and 5.45, respectively, were obtained from wind-tunnel tests in air. The pitot-pressure distribution was measured in the shock layer of a 15° blunted cone at angle of attack. Pitot traverses were made at two axial stations to show the thinning of the entropy layer. At 0° angle of attack, the experimental pressure distributions and pitot traverses of the shock layer compare favorably with the inviscid numerical theory but some viscous effects were observed. Theory and experiment both demonstrate the existence of a high total-pressure layer enclosing the low total-pressure layer adjacent to surfaces of blunted cones. The high total-pressure layer is a result of an inflection of the shock that is a characteristic of the three-dimensionality of flow over blunted cones. For windward surfaces, increasing angle of attack brings the high total-pressure layer in close proximity to the cone surface; this may influence transition of the boundary layer. Author

N65-30956*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A DESCRIPTION OF NUMERICAL METHODS AND COMPUTER PROGRAMS FOR TWO-DIMENSIONAL AND AXISYMMETRIC SUPERSONIC FLOW OVER BLUNT-NOSED AND FLARED BODIES
Mamoru Inouye, John V. Rakich, and Harvard Lomax Washington, NASA, Aug. 1965 37 p refs
(NASA-TN-D-2970) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The computer programs developed at Ames Research Center for calculating the inviscid flow field around blunt-nosed bodies are described briefly and their application to specific shapes is demonstrated. The programs solve numerically the exact equations of motion for plane or axisymmetric bodies at zero angle of attack and for a perfect gas or a real gas in thermodynamic equilibrium. An inverse method is used for the subsonic-transonic region, and the method of characteristics is used for the supersonic region. Results are shown for several body shapes in both perfect and real gas flow, including a comparison between air and a CO_2-N_2 mixture. Presented are shock-wave shapes and distributions of pressure and other flow variables along the body and across the shock layer. Author

N65-31062*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOME ASPECTS OF THE FLIGHT DYNAMICS OF THE AEROBEE 350 IN REGION OF PITCH-ROLL COUPLING

J. T. Lawrence Jun. 1965 55 p refs

(NASA-TM-X-55236; X-671-65-252) CFSTI: HC $3.00/MF $0.50 CSCL 01A

The motion in the region of pitch-roll coupling is examined for an Aerobee 350 having a 2° thrust misalignment located in a plane 20° from the reference fin. Nine computer runs are used to illustrate the effects of changing various vehicle characteristics and a discussion is given of the theory involved. Author

N65-31159# National Research Council of Canada, Ottawa (Ontario).

A SURFACE FLOW SOLUTION AND STABILITY DERIVATIVES FOR BODIES OF REVOLUTION IN COMPLEX SUPERSONIC FLOW. PART I: THEORY AND SOME REPRESENTATIVE RESULTS

L. H. Ohman (Natl. Aeron. Estab.) Nov. 1964 55 p refs

(NRC-LR-418; NRC-8348)

A method of determining the surface flow velocities for arbitrary pointed bodies of revolution in complex supersonic flow, i.e., flow due to constant incidence, constant pitching velocity and constant lateral acceleration, has been derived and a corresponding numerical procedure developed. Good correspondence between results of the present method with available "exact", and exact linear results for cones has been found for the range 0 to 1 of the similarity parameter $\beta\tau$. Using the exact isentropic pressure-velocity relation, expressions for the limiting value of the pressure coefficient derivatives as the independent variable approaches zero, have been derived, that are then integrated to obtain the corresponding stability derivatives. Comparison of representative results with available exact theoretical values and with experiments show good agreement. Author

N65-31207# Itek Corp., Palo Alto, Calif. Vidya Div.

THEORETICAL AERODYNAMICS OF FLEXIBLE WINGS AT LOW SPEEDS. PART IV: EXPERIMENTAL PROGRAM AND COMPARISON WITH THEORY

J. A. Burnell and J. N. Nielson 15 Feb. 1965 129 p refs

(Contract Nonr-3728(00))

(VIDYA-172, Pt. IV; AD-617925)

Low-speed measurements have been made of the aerodynamic characteristics of triangular one-lobed and two-lobed parawings of aspect ratios 1, 2, and 3. It was found that this theory is adequate for determining the canopy shapes, the luffing boundaries, and the lift characteristics for parawings of low to moderate slackness ratio. The measured center of pressure positions are slightly forward of the theoretical position as a result, it is thought, of the presence of the leading-edge members. Also, the aerodynamic design of the leading-edge members is such that from 20 percent to 70 percent of the theoretical leading-edge suction is realized. The maximum lift-drag ratios appear to be adversely affected by trailing-edge flutter which in some cases is so intense as to preclude aerodynamic testing at angles of attack for maximum lift-drag ratio. A parawing of aspect ratio 8.5 with a taut trailing-edge cable exhibited no flutter, and when the tension was relieved the flutter was intense and the maximum lift-drag ratio actually increased. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-30296# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Flight Research Dept.

GROUND SIMULATOR EVALUATIONS OF COUPLED ROLL-SPIRAL MODE EFFECTS ON AIRCRAFT HANDLING QUALITIES

F. D. Newell Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Mar. 1965 54 p refs

(Contract AF 33(615)-1253)

(TC-1921-F-1; AFFDL-TR-65-39; AD-617353)

A systematic investigation of the lateral handling qualities of fighter aircraft on an en route IFR mission was made in a fixed-base ground simulator. The suitability of a wide range of roll and spiral mode root locations was examined with particular emphasis placed upon determining the effects of complex roll-spiral roots. The complex roll-spiral roots were produced with several feasible combinations of stability derivatives. Interaction effects of the Dutch roll mode roots were examined, including the effects of the proximity of these roots to the complex roll-spiral mode roots. Assessment of the flying qualities is reported in terms of the evaluation comments and ratings given by two pilots. In general the complex roll-spiral configurations that were evaluated were too difficult to control in roll to consider their handling quality characteristics as acceptable for fighter aircraft. Author

N65-30498# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AIR FORCE REVIEW Selected Articles

16 Mar. 1965 31 p Transl. into ENGLISH from Wojskowy Przeglad Lotniczy (Warsaw), no. 11, 1963 p 3-25

(FTD-TT-64-217/1+2; AD-460177)

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N65-30569# College of Aeronautics, Cranfield (England).

MEASUREMENTS OF THE MOMENTS OF INERTIA OF A HAWKER SIDDELEY DOVE Mk. 5 AIRCRAFT

W. G. Bradley Apr. 1965 22 p refs

(CoA-N-AERO-165)

This note describes the measurement of the moments of inertia in roll, pitch and yaw of a Hawker-Siddeley (de Havilland) Dove Mk. 5 aircraft, using a spring-restrained oscillation technique. Using the present equipment it did not prove possible to measure the product of inertia. Inertias were measured in six different fuel conditions; and the results are given. A device was developed which measures the periods of oscillation of large structures, quicker and more accurately than hitherto possible. This device is described in the Appendix. Author

N65-30786# Aerospace Corp., El Segundo, Calif. Fluid Mechanics Dept.
PERFORMANCE AND CHARACTERISTICS OF 67.2-FOOT EXTENDED SKIRT CANOPY PARACHUTE WITH SINGLE CONICAL EXTENSION
Heinrich K. Epple 1 Apr. 1965 32 p refs
(Contract AF 04(695)-469)
(TDR-469(5110-01)-2; SSD-TR-65-42; AD-616885)

The details and results of two parachute drop tests made at El Centro, California, on 22 October 1964, are discussed. The parachutes were a modification of a basic design to permit the aerial recovery of payloads up to approximately 1500 pounds. Discussions and conclusions pertaining to the dynamic performance of these modified parachutes during descent and their physical condition after engagement with the aircraft retrieval system hardware are included. Author

N65-30787# Ling-Temco-Vought, Inc., Dallas, Tex. Vought Aeronautics Div.
DIRECT LIFT CONTROL AS A LANDING APPROACH AID IN THE F-8C AIRPLANE. SIMULATOR AND FLIGHT TESTS
J. D. Etheridge and C. E. Mattlage 31 Dec. 1964 177 p refs
(Contract N62269-2403)
(Rept.-2-53310/4R-175; AD-616626)

The direct lift control system varied the droop of the aileron as a flap through a control knob on the stick. This system provided a more rapid means of changing altitude than normal longitudinal control. Direct lift control was found to be superior to normal longitudinal control for maintaining a precise glide path. Author

N65-30987# United Aircraft Corp., Norwalk, Conn. Norden Div.
UNIVERSAL CONTACT ANALOG DISPLAY (UCAD) RESEARCH. PHASE I: SYSTEMS ANALYSIS Technical Progress Report
Peter Williams 15 Apr. 1965 112 p refs
(Contract Nonr-4489(00))
(Rept.-1161-R-0011; AD-616650)

The goal of this research is the development of design specifications for a universal raster-scan TV flight instrument suitable for use in fixed-wing, rotary-wing, and VTOL aircraft. Information parameters have been identified and quantified by means of a systematic analysis of aircraft performance and flight information requirements. Mission segments, consisting of common flight maneuvers, have been defined as a result of mission analyses. Aircraft response criteria are developed based on a combination of military handling quality specifications and pilot opinion reports. Display augmentation requirements have been specified through the allocation of loop closure functions to the pilot/display loop, the AFCS loop, or a combination of both. Total display information requirements for flight control, propulsion systems, and special mission parameters have been established as a result of a commonality study of required usage throughout the mission. Author

N65-31018# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Section.
THE N.A.E. AIRBORNE FLIGHT SIMULATORS
D. F. Daw Natl. Res. Council of Can., 26 Nov. 1964 26 p refs Presented at Can. Aeron. and Space Inst., Test Pilots Symp., RCAF Station, Uplands

To obtain data concerning the handling qualities requirements for use by V/STOL aircraft designers, two airborne simulators consisting of a variable stability helicopter and equipped with electrical analogue models to provide for the variation of the aircraft responses were developed. One of the simulators, with the provision to modify three angular rate responses, is in use and gathers data concerning handling qualities requirements. The second simulator is expected to be more versatile due to the addition of a provision to modify a fourth degree of freedom and to increase the natural frequencies of the three angular rate control loops. R.W.H.

N65-31069# Northrop Corp., Hawthorne, Calif. Norair Div.
VTOL AT NORTHROP. THE STATUS OF FLIGHT CONTROL RESEARCH AND DEVELOPMENT
D. L. Hirsch, J. B. Sinacorn, J. T. Gallagher, and F. B. O'Connell, Jr. Nov. 1964 65 p refs
(NOR-64-292)

This report summarizes recent research activities in the area of VTOL flight control and makes specific recommendations for an expanded effort in the next two fiscal years. Current research programs are reviewed and results are presented in detail. The intended overall direction of future research is described, and immediate requirements are outlined. In addition to specific studies, the most pressing of these are the need for a research aircraft and the improvement of simulation and model test facilities. A comprehensive program for accelerated research activities in the VTOL flight control field for fixed wing aircraft is outlined. Author

N65-31100*# National Aeronautics and Space Administration, Washington, D. C.
CONFERENCE ON AIRCRAFT OPERATING PROBLEMS
1965 335 p refs Conf. held at Langley Res. Center, Langley Station, Va., 10–12 May 1965
(NASA-SP-83) CFSTI: HC $3.00/MF $1.75 CSCL 01B

Conference papers on runway studies, noise problems, subsonic, supersonic and general aviation aircraft, V/Stol and Stol aircraft are presented. For individual titles see N65-31101–N65-31134.

N65-31101* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
RECENT STUDIES OF RUNWAY ROUGHNESS
Garland J. Morris and Albert W. Hall *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 1–7 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Recent studies of NASA research related to aircraft operating problems on rough runways are presented. Some of these investigations were conducted cooperatively with the airport operators, with the Federal Aviation Agency, and with the U.S. Air Force. The studies show that criteria based on power spectral levels of runway-profile data are not sufficient to define acceptable levels of runway roughness from the piloting viewpoint. Becuase of the large variation in response characteristics between various types of aircraft, a runway may be acceptable for some aircraft and unacceptable for others. A criterion for roughness, therefore, should be expressed in terms of aircraft response–preferably, cockpit acceleration. A criterion suggested is that the maximum vertical acceleration in the cockpit should

not exceed ±0.4g for sections of the runway where precise aircraft control is required. Author

N65-31102* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRACTION OF PNEUMATIC TIRES ON WET RUNWAYS
Walter B. Horne and Upshur T. Joyner *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 9–17 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Recent work on the traction of pneumatic tires on wet runways is discussed, and it is shown that a loss of tire traction adversely affects cross-wind landings. The effect of runway surface texture is discussed, and a simple method for measuring surface texture is described. A preliminary correlation of tire traction with surface texture is shown. Results of work at Langley Research Center on the use of air jets to improve tire traction on wet or flooded runways indicate that this is a promising approach for alleviating the large losses in tire braking and sideways traction that occur when tire hydroplaning occurs on a flooded runway. Author

N65-31103* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF ATMOSPHERIC TURBULENCE DATA
Roy Steiner *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 19–27 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Turbulence data obtained from recent flights of the U-2 airplanes and from the National Severe Storms Project agree in general with the results obtained in previous investigations. The data show that nonstorm turbulence decreases in intensity and amount with increasing altitude. Less than 2 percent of the flight distance was in turbulence at altitudes above 50,000 feet. It also appears that the root-mean-square gust velocities of the composite turbulence patches may be 15 to 20 percent lower than previous estimates. Author

N65-31104* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY STUDY OF STEEP INSTRUMENT APPROACH OF THREE CONVENTIONAL AIRCRAFT
Albert W. Hall, Robert A. Champine, and Donald J. Mc Ginley, Jr. *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 29–36 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Preliminary studies of steep instrument approaches have been conducted with three conventional aircraft. Six-degree approach paths were found to be acceptable. A margin of 3° to 4° in maximum glide slope was available to allow for flight-path corrections. Control of the lateral-directional axis was the most difficult problem for pilots making either steep or conventional approaches; split-axis control reduced the pilot workload during this operation. Author

N65-31105* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME FACTORS AFFECTING FATIGUE OF AIRCRAFT STRUCTURES
Herbert F. Hardrath *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 37–44 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Several points of interest to the operator of aircraft are reviewed. Rates of crack propagation tend to increase and residual static strength tends to decrease as the strength of the materials increases. Ground-air-ground and other negative loadings accelerate the damage to certain critical sections so that in first approximation, the fatigue life in these areas should be estimated on the basis of the number of flights, rather than the flight miles or flight hours. Regular inspection for cracks is necessary to assure safe operation of existing flight structures. Author

N65-31106* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
USE OF VERY WEAK RADIATION SOURCES TO DETERMINE AIRCRAFT RUNWAY POSITION
Fred J. Drinkwater, III and Bernard R. Kibort *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 45–51 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Various methods of providing runway information in the cockpit during the take-off and landing roll have been proposed. The most reliable method has been to use runway distance markers when visible. Flight tests were used to evaluate the feasibility of using weak radioactive sources to trigger a runway distance counter in the cockpit. The results of these tests indicate that a weak radioactive source would provide a reliable signal by which this indicator could be operated. Author

N65-31108* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATOR EVALUATION OF A DISPLAY FOR MANUAL ZERO-ZERO LANDINGS
Joseph G. Douvillier, Jr. *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 61–71 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

A research program to study in flight the display, sensor, and computer requirements for airborne, manually piloted zero-zero landing systems is being undertaken at the Ames Research Center. An evaluation has been made, on a flight simulator, of the display which will be used in the flight tests. Results show that on the simulator the pilots performed at least as well when they used the display for zero-zero approaches and landings as they did when they made simulated ILS approaches followed by simulated VFR breakouts and landings. In some aspects, particularly in the presence of crosswind, performance for the zero-zero display landings was somewhat better than for the ILS-VFR landings. Eight configurations of the display were studied in an attempt to evaluate the several elements in the display. There was no evident difference among the eight display configurations. The pilots who participated in the simulator program doubt that this result will carry over into flight. Author

N65-31109* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FACTORS RELATING TO THE AIRPORT-COMMUNITY NOISE PROBLEM
Harvey H. Hubbard, Jimmy M. Cawthorn, and W. Latham Copeland *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 73–81 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Factors relating to the airport-community noise problem are discussed herein. The noise problems are associated with aircraft landing approaches, take-offs, and climbouts in communities near commercial airports. The main objectives are to identify the significant factors involved in the problem, to define some of their interrelationships, and to present recent related research information from NASA in-house and contract studies. Changes in the types of aircraft power plants, the aircraft operating procedures, and the community itself are all judged to be important; however, these changes should not be made without understanding the associated human-response implications. Author

N65-31110* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
PRELIMINARY MEASUREMENTS OF TAKE-OFF AND LANDING NOISE FROM A NEW INSTRUMENTED RANGE
Carole S. Tanner and Norman J. Mc Laod *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 83-90 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

This paper describes the NASA noise-survey instrumentation system presently in use at Edwards Air Force Base, California, and presents preliminary noise data from an F-104 airplane. Also presented are noise measurements of the XB-70 and 707-131B airplanes obtained with essentially the same equipment at another location. The difference between measured noise levels for the XB-70 and 707 is illustrated and comparisons of perceived noise levels are made. The adequacy of noise predictions is discussed briefly. Author

N65-31111* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPERATIONAL EXPERIENCES OF TURBINE-POWERED COMMERCIAL TRANSPORT AIRPLANES
Paul A. Hunter and Walter G. Walker *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 91-99 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Recent results obtained from NASA V-G and VGH recorders installed on commercial turbine-powered transports have indicated that exceedances of placard speeds appear to have been significantly reduced since the placard speeds have been redefined and changes made in the aural warning. Oscillatory accelerations and unusual events, such as large or rapid departures from the planned flight profile, occur less frequently. Landing-impact accelerations are higher for turbine transports than for piston transports and vary with operator. The total in-flight acceleration experiences for turbine transports, however, are not significantly different from those for four-engine piston transports. Author

N65-31112* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATOR STUDIES OF THE DEEP STALL
Maurice D. White and George E. Cooper *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 101-111 (See N65-31100 10-02) CFSTI: HC $3.00/MF $1.75

Simulator studies of the deep-stall problem encountered with modern airplanes are discussed. The results indicate that the basic deep-stall tendencies produced by aerodynamic characteristics are augmented by operational considerations. Because of control difficulties to be anticipated in the deep stall, it is desirable that adequate safeguards be provided against inadvertent penetrations. Author

N65-31113* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEEP-STALL AERODYNAMIC CHARACTERISTICS OF T-TAIL AIRCRAFT
Robert T. Taylor and Edward J. Ray *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 113-121 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

A wind-tunnel research program has been undertaken by the NASA to study the aerodynamic characteristics of T-tail aircraft at high angles of attack. The program was designed to show the effects on longitudinal stability and control of several configuration variables. The results to date do not allow the formulation of general design rules, but the effects of several configuration variables have been noted to have a prime influence on the post-stall characteristics. An increase in tail size, changes in the location of fuselage-mounted engine nacelles, and reduced fuselage-forebody lift were all found to have a beneficial effect on static longitudinal stability at high angles of attack. Author

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N65-31114* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT TESTS RELATED TO JET-TRANSPORT UPSET AND TURBULENT-AIR PENETRATION
William A. Andrews, Stanley P. Butchart, Thomas R. Sisk, and Donald L. Hughes *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 123-135 ref (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

A flight program, utilizing a Convair 880 and a Boeing 720 airplane, was conducted in conjunction with wind-tunnel and simulator programs to study problems related to jet-transport upsets and operation in a turbulent environment. During the handling-qualities portion of the program the basic static stability of the airplanes was considered to be satisfactory and the lateral-directional damping was considered to be marginal without damper augmentation. An evaluation of the longitudinal control system indicated that this system can become marginal in effectiveness in the high Mach number and high dynamic-pressure range of the flight envelope. From the upset and recovery phase of the program it was apparent that retrimming the stabilizer and spoiler deployment were valuable tools in effecting a positive recovery; however, if these devices are to be used safely, it appears that a suitable g-meter should be provided in the cockpit because the high control forces in recovery tend to reduce the pilot's sensitivity to the actual acceleration loads. Author

N65-31115* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATOR INVESTIGSTIONS OF THE PROBLEMS OF FLYING A SWEPT-WING TRANSPORT AIRCRAFT IN HEAVY TURBULENCE
Richard S. Bray and William E. Larsen *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 137-148 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

An investigation of several factors which may contribute to the problem of piloting jet transport aircraft in heavy turbulence was conducted by using a piloted simulator that included the most significant airplane response and cockpit vibrations induced by rough air. Results indicated that the primary fuselage structural frequency contributed significantly to a distracting cockpit environment, and there was obtained evidence of severely reduced instrument flight proficiency during simulated maneuvering flight in heavy turbulence. It is concluded that the addition of similar rough-air response capabilities to training simulators would be of value in pilot indoctrination in turbulent-flight procedures. Author

N65-31116* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SIMULATOR STUDY OF TAKE-OFF CHARACTERISTICS OF PROPOSED SUPERSONIC TRANSPORTS
Charles T. Jackson, Jr. and C. Thomas Snyder *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 149-157 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Fixed-cockpit piloted simulator studies of delta-planform and variable-wing-sweep supersonic transport configurations are being conducted at the Ames Research Center to investigate the handling qualities and certification requirements related to the take-off maneuver. Validation of the simulation was achieved by duplicating the take-off certification program of a subsonic jet transport. The present paper is limited to a discussion of normal take-off, minimum control speed (ground), rotation characteristics, and initial climbout. Comparisons of the

take-off characteristics are made between the supersonic transport and the current class of subsonic jet transports. Results indicate that minimum control speed (ground) characteristics are a function of thrust-weight ratio, the time provided for SST rotation should be at least as long as that for the subsonic jet transports, abused take-offs are more likely to result in tail scrapes, and climbout below the minimum drag speed requires that the pilot carefully monitor airspeed. Author

N65-31120* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
REVIEW OF THE XB-70 FLIGHT PROGRAM
Thomas R. Sisk, Kirk S. Irwin, and James M. Mc Kay *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 183–192 ref (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

The status of the XB-70 flight program is presented, and the program is outlined in a table. Graphic presentations of initial data are given for takeoff, flight, landing, and oscillation. Also shown graphically are transonic trim characteristics, the difference between actual and predicted longitudinal trim, and landing-loads data at main-gear and nose-gear impact. The data in general show that the airplane substantiated performance predictions, achieving a Mach number of 2.43 at 64,500 ft in 11 flights, with no unforeseen problems indicated. The stability and control characteristics at subsonic speeds appear satisfactory with stability augmentation on and off. A longitudinal trim discrepancy from predictions is noted in the transonic region which appears to decrease with increasing supersonic speed. L.S.

N65-31121* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONSIDERATION OF FUEL REQUIREMENTS FOR SUPERSONIC TRANSPORT OPERATION
Joseph W. Stickle *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 193–202 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

An analysis of the interaction of operational environment and aircraft characteristics of the supersonic transport (SST) in the areas of design-range and reserve-fuel requirements has been made. Design-range requirements are considered in relation to the effects of wind, temperature, flight-level assignment, and payload variation. An approach toward combining en route and holding reserve requirements while maintaining protection equivalent to that provided subsonic jet transport operations by the present civil air regulation en route plus holding reserves is given. This approach results in a savings in reserve fuel over that required by separate requirements. Author

N65-31122* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECT OF YAW COUPLING IN TURNING MANEUVERS OF LARGE TRANSPORT AIRCRAFT
Walter E. Mc Neill and Robert C. Innis *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 203–213 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

A study has been made, using a piloted moving simulator, of the effects of the yaw-coupling parameters N_p and $N_{\dot{\delta}_a}$ on lateral-directional handling qualities of a large transport airplane at landing-approach airspeed. It is shown that the desirable combinations of these parameters tend to be more proverse when compared with values typical of current aircraft. Results of flight tests in a large variable-stability jet transport showed trends which were similar to those of the simulator data. Areas of minor disagreement, which were traced to differences in airplane geometry, indicate that pilot consciousness of side acceleration forces can be an important factor in handling qualities of future long-nosed transport aircraft. Author

N65-31124* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IMPLICATIONS OF THE EFFECTS OF SURFACE TEMPERATURE AND IMPERFECTIONS ON SUPERSONIC OPERATIONS
John B. Peterson, Jr. and Albert L. Braslow *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 227–233 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

The effects of surface temperature and imperfections on the drag of the supersonic transport are discussed. The relationships among surface temperature, emissivity, and skin friction are reviewed and the importance of manufacturing and maintenance imperfections is indicated. Author

N65-31125* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PREDICTION OF AIRPLANE SONIC-BOOM PRESSURE FIELDS
Harry W. Carlson, F. Edward Mc Lean, and Wilbur D. Middleton *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 235–244 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

This paper presents a discussion of the sensitivity of supersonic-transport design and operation to sonic-boom considerations and shows the necessity for a study of these problems early in the development program. Methods of predicting pressure signatures are outlined and examples of the correlation of these estimates with wind-tunnel and flight measurements are shown. Estimates of sonic-boom characteristics for a representative supersonic transport show that in the critical transonic acceleration portion of the flight, overpressures somewhat lower than estimated by the use of far-field assumptions may be expected. Promising design possibilities for the achievement of further overpressure reductions are explored. Author

N65-31126* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIGNIFICANCE OF THE ATMOSPHERE AND AIRCRAFT OPERATIONS ON SONIC-BOOM EXPOSURES
Domenic J. Maglieri and David A. Hilton *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 245–256 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

The information of the paper is in the form of a status report on the state of knowledge of sonic-boom phenomena, dealing first with the pressure buildups in the transonic speed range and with the lateral extent of the pattern in steady flight for quiescent atmospheric conditions. There are also discussions of recent data from flight-test studies relating to atmospheric dynamic effects on the sonic-boom signatures, and finally, brief discussions of the significance of signature shape on the response of people and structures. The acceleration and lateral-spread phenomena appear to be fairly well understood and predictable for current and future aircraft. Variations in the sonic-boom signature as a result of the effects of the atmosphere can be expected during routine operations. From the data evaluated to date, very similar variations in pressure signatures are noted for both fighter and bomber aircraft. The greatest questions still exist in the area of community acceptance of sonic booms. A more definitive answer to the community-acceptance problem will have to await adequate flight experience with larger aircraft. Author

N65-31127* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPERATIONAL EXPERIENCES OF GENERAL AVIATION AIRCRAFT
Joseph W. Jewel, Jr. and Walter G. Walker *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 257–263 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

An investigation is currently under way to determine the operational practices and load experiences of general aviation aircraft performing five basic types of operations: twin-engine executive, single-engine executive, personal, instructional, and commercial survey. Limited data obtained to date from aircraft engaged in these operations indicate that aircraft are generally being operated within the limits to which they were designed. Author

N65-31128* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRPLANE SPINNING
James S. Bowman *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 265–273 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

A summary on spinning is presented to point out the state of the art and the most important parameters, and to show the effects of these parameters on the spin and spin-recovery characteristics. The discussion presented applies to the fully developed spin. The principal factors in spinning are mass distribution, which is by far the most important single parameter, and tail design, which is particularly important for conditions of zero or near-zero loading. By knowing the mass distribution and tail design, it is possible in many cases to predict whether an airplane has satisfactory spin-recovery characteristics. In other cases, however, it is necessary to make spin tests to assure satisfactory recovery. Author

N65-31129* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPERATING PROBLEMS PECULIAR TO V/STOL AND STOL AIRCRAFT
John P. Campbell *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 275–280 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

This paper covers the unique features and different modes of operation of V/STOL and STOL aircraft which result in new operating problems and serves to introduce the papers which deal in more detail with some of the more important V/STOL and STOL operating problems. Author

N65-31130* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
V/STOL AIRCRAFT OPERATION IN THE TERMINAL AREA
John P. Reeder *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 281–286 ref (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Some aspects of V/STOL operation in a terminal area have been presented. A V/STOL instrument approach with present-day displays and guidance systems requires about 5 minutes at low speeds, but this time could be cut to 1-1/2 to 2 minutes if the displays and guidance systems were improved. In order to keep approach-pattern time to a minimum, the conversion process should be simplified by interconnecting as many operations as possible with one control. Adequate vectoring for the lifting system, attitude stabilization to prevent excessive wandering, and automatic glide-path control for approaches over 6° will probably be required also. Author

N65-31131* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GROUND EFFECTS ON V/STOL AND STOL AIRCRAFT
Richard E. Kuhn *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 287–298 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Ground effects on V/STOL and STOL aircraft arise from the fact that these aircraft support themselves by deflecting air downward. The presence of the ground interrupts this downward flow with attendant effects on both the ground and the aircraft. The effects of self-generated turbulence will not be serious if adequate control is provided, and this annoyance to the pilot can be reduced by providing artificial damping. The avoidance of ground-erosion damage involves proper preparation and housekeeping of the landing site for high-disk-loading vehicles and proper operating procedures to avoid running into debris. Research is still in progress to obtain a better understanding of hot-gas ingestion and means of reducing it; its effects can be minimized by vectoring the exhaust rearward and using a short running take-off. The lift losses and trim changes in STOL operations will require an extra margin of power and velocity to compensate for this problem. Author

N65-31132* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OPERATIONAL EXPERIENCES WITH THE X-14A DEFLECTED-JET VTOL AIRCRAFT
L. Stewart Rolls *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 299–307 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

During 5-1/2 years of flight research with a deflected-jet VTOL aircraft, a number of operational problems were experienced and investigated. These experiences can be grouped into two general categories: (1) the effects of the jet engine and its operation and (2) the restrictions imposed upon the pilot's operation due to reduced visual reference. This report is an examination of these problems and, in some cases, presents possible solutions to these problems. Author

N65-31133* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME PERFORMANCE AND HANDLING-QUALITIES CONSIDERATIONS FOR OPERATION OF STOL AIRCRAFT
Seth B. Anderson, Hervey C. Quigley, and Robert C. Innis *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 309–317 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Studies of a number of STOL aircraft show that relatively high maximum lift coefficients and large increases in lift due to power are within the present state of the art. With these lift characteristics, approach speeds of the order of 60 knots for aircraft of moderate wing loading can be realized. Full advantage of the STOL performance of aircraft such as those discussed herein may not be realized on a routine operational basis, however, without some form of damping augmentation system because of lateral-directional handling considerations, particularly for large aircraft operating under instrument flight conditions. Satisfactory characteristics can be obtained by use of only a servodriven rudder. Additional experience is needed to determine how the STOL aircraft is to be operated before more firm requirements for augmentation systems can be established. Author

N65-31134* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED FLIGHT CHARACTERISTICS OF A POWERED-LIFT JET TRANSPORT DURING THE LANDING APPROACH

Robert O. Schade and Harold L. Crane *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 319-327 refs (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

A flight-test program to determine the flight characteristics of large jet transports equipped with powered-lift systems indicated the following results: Speed margins appear to be primarily related to power-on stall speeds. At these speed margins, the maneuver margins were adequate and did not appear to be a problem or limiting factor during powered-lift operation. No large detrimental effects on handling qualities were apparent but in some areas stability augmentation would be required to obtain satisfactory flight characteristics. Use of the powered-lift airplane would result in a sizable increase in the noise levels; these increases are primarily the result of higher engine power settings in the approach. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-30486*# Monsanto Research Corp., Everett, Mass.
DRY TAPE BATTERY
15 Jan. 1964 52 p
(NASA-CR-64219) CFSTI: HC $3.00/MF $0.50 CSCL 10C

Battery systems utilizing dry tape continuous feed of active components are considered in terms of the dry tape concept, its inherent advantages, testing data accumulated, and possible applications. The heart of the dry tape system is a coated tape based on the magnesium-meta-dinitrobenzene couple with the center portion either an ion exchange membrane or a porous separator tape. Magnesium fuel is applied as a thin foil in a stoichiometric amount. The electrolyte is completely isolated from other electrochemical components, and its containment is by microcapsules although other encapsulating methods are possible. Tape base materials and coating analysis are considered, and the laboratory test device is presented along with the necessary hardware development. Testing results are given for various polypropylene and nylon tapes, current density at the zinc collector, and effect of tape speed and current density on cathode utilization. System applications are considered for high energy density couples, programmed power, constant voltage operation, and reserve, secondary, and thermal systems. M.W.R.

N65-30507# Washington Univ., Seattle. Applied Physics Lab.
INVESTIGATION OF THE CAUSES OF INTERCELL CLOGGING IN HIGH-DRAIN, WATER-ACTIVATED, SILVER CHLORIDE-MAGNESIUM BATTERIES
Duane W. Faletti and Larry F. Nelson (Naval Torpedo Sta., Keyport, Wash.) 27 Apr. 1965 117 p refs Work performed jointly by Wash. Univ. and Naval Torpedo Sta.
(APL-UW-6415; AD-467860)

Early in 1960, premature loss of power and erratic control voltage were experienced with the Battery, Water Activated, Mark 67 Mod 0, which is a silver chloride magnesium sea-water-activated battery. The results of the program to learn the causes of these failures are presented. The failures are the result of an intercell buildup of insoluble reaction products, which has been given the name "black clogging." Black clogging results from use in the battery of AZ61 magnesium alloy which has been subjected to precipitation heat treatment instead of the specified solution heat treatment. A practical and reliable test based upon X-ray diffraction techniques was developed to determine the state of heat treatment of AZ61 alloy. An alternate test based upon electrical conductivity was studied and found to show some promise, but further development is required. Several other types of clogging were observed, among which only gray clogging was significant. Gray clogging, named after the color of the insoluble reaction products which filled the intercell spaces, was found to result from premature exhaustion of the cathodes brought on by electrical shorts. This type of clogging can be avoided if proper manufacturing and quality control procedures are followed. Author

N65-30542*# Eagle-Picher Co., Joplin, Mo. Couples Dept.
INVESTIGATIONS LEADING TO THE DEVELOPMENT OF A PRIMARY ZINC-SILVER OXIDE BATTERY OF IMPROVED PERFORMANCE CHARACTERISTICS, 1 JANUARY-31 MARCH 1965
[1965] 46 p
(Contract NAS8-5493)
(NASA-CR-64223) CFSTI: HC $2.00/MF $0.50 CSCL 10C

Considerable effort has been expended in studies directed at discovering a procedure resulting in optimum utilization of positive active materials. This has been done primarily by studying the electroformation process associated with the silver plate. Under experimental conditions, procedures have been described whereby sintered silver plates consistently display oxygen content indicating more than 95% of the divalent capacity. Other studies described include the following: A) Effect of Silver-Zinc Ratio; B) Electrolyte Additives; and C) Effects of Cell Tightness and Quantity of Electrolyte. Author

N65-30635*# Franklin Inst., Philadelphia, Pa.
OPERATION AND MAINTENANCE MANUAL FOR THE FRANKLIN INSTITUTE LABORATORIES UNIVERSAL PULSER, FILUP 2 Final Manual
Oct. 1964 128 p
(Contract NAS9-2106)
(NASA-CR-65077; FM-B2154) CFSTI: HC $4.00/MF $1.00 CSCL 21B

The FILUP 2 is designed for testing electroexplosive devices. This instrument combines the capabilities of three earlier instruments to provide full input testing for any known electroexplosive device. In addition it can provide an input current of constant slope. This manual covers the circuit principles, operation, circuit description and maintenance of the FILUP 2. Additional information on testing electric initiators and analysis of the results of these tests is presented. N.E.A.

N65-30693*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS. VOLUME 2: DESIGN MANUALS
J. N. Ellis and F. A. Collins [1965] 415 p
(Contract NAS3-2783)
(NASA-CR-54320) CFSTI: HC $7.15/MF $2.00 CSCL 10B

Design formulae for brushless ac generators for use in space auxiliary power systems are presented. Included are design curves and tables, and design manuals for a salient-pole-wound-pole synchronous ac generator, a non-salient wound rotor synchronous ac generator, rotating coil ac Lundell-type generators, a single inside stationary coil ac Lundell-type generator, a two inside coil stationary coil ac Lundell-type generator, and two coil and single coil outside coil ac Lundell-type generators. R.N.A.

N65-30694*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS, VOLUME 3
J. N. Ellis and F. A. Collins 26 Apr. 1965 301 p
(Contract NAS3-2783)
(NASA-CR-54320) CFSTI: HC $7.00/MF $1.75 CSCL 10B

Design manuals are presented for an axial air gap stationary coil salient pole synchronous ac generator, a homopolar inductor ac generator, and permanent magnet salient pole ac generators. Derivations of equivalent circuits describing steady state and transient performance, and electric symbol tables are included. R.N.A.

N65-30695*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS, VOLUME 4
J. N. Ellis and F. A. Collins 26 Apr. 1965 391 p
(Contract NAS3-2783)
(NASA-CR-54320) CFSTI: HC $7.00/MF $2.00 CSCL 10B

Presented are the nomenclature for a generator thermal analysis computer program (Fortran), and computer programs and test data for the following generators: salient-pole, wound-pole synchronous ac generator; a nonsalient-pole, wound-rotor, synchronous generator; a rotating-coil, Lundell-type ac generator; an inside, single-coil, stationary-coil Lundell-type ac generator; and an inside two-coil, stationary-coil Lundell ac generator. G.G.

N65-30696# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS, VOLUME 5
J. N. Ellis and F. A. Collins 26 Apr. 1965 327 p refs
(Contract NAS3-2783)
(NASA-CR-54320) CFSTI: HC $7.00/MF $1.75 CSCL 10B

Computer program and test data are presented for a two-coil and single-coil outside-coil ac generator, a homopolar ac generator, and a permanent magnet ac generator. Also included are derivations for various generator data, and data on the effect of increasing the air gap in an ac generator. R.N.A.

N65-30795# Frankford Arsenal, Philadelphia, Pa.
DYNA-SOAR ESCAPE SYSTEM, PROPELLANT ACTUATED DEVICES
Raymond C. Sutter May 1965 67 p
(FA-R-1757; AD-616525)

Frankford Arsenal has subjected propellant actuated devices, originally developed for use in conventional aircraft, to special vibration tests in order to qualify them for use in the Dyna-Soar (X20) Escape System. Four initiators were developed for use in the system and the ejection seat catapult was tested under high g loads to determine safety of the device if initiated during high down-load conditions. Author

N65-30805# Monsanto Research Corp., Everett, Mass. Boston Lab.
SELF-CONTAINED GENERATOR FOR SHELTER USE Final Report, 1 Jul. 1963–30 Jun. 1964
Bela M. Fabuss and Alexander S. Borsanyi 15 Oct. 1964 48 p refs
(Contract OCD-PS-64-7)
(MRB6024F; AD-616639)

A self-contained generator was designed, assembled, and operated to provide oxygen, water, and electric power in shelters through the decomposition of 90% hydrogen peroxide. The decomposition of hydrogen peroxide in this self-pressurizing unit resulted in complete conversion to oxygen and water at 1300° F and pressures up to 200 psig. A high speed 2 kw turbine, specially designed and manufactured by General Thermodynamics Corp. for this project, was successfully operated in conjunction with a high speed generator. The maximum overall efficiency of the system was 63.4 per cent. For a 100-man shelter, 19.3 lb/hr or 40 gallons per day of 90% hydrogen peroxide will provide the minimum oxygen and water requirement and yield about 0.55 kw (continuous) electrical power or 13.2 kw-hr per day of electrical energy. Author

N65-30843*# Pennsylvania Univ., Philadelphia, Pa. Inst. for Direct Energy Conversion.
[MATERIALS ENGINEERING, PLASMA RESEARCH, AND ELECTROCHEMICAL STUDIES IN THE DEVELOPMENT OF DIRECT ENERGY CONVERSION METHODS] Status Report
4 Jan. 1965 100 p refs
(Grant NsG-316)
(NASA-CR-64303; INDEC-SR-5) CFSTI: HC $3.00/MF $0.75 CSCL 10A

Progress is reported on the following subjects: *Partial Molar Properties of Magnesium Base Binary Thermal Energy Storage Materials; Phase Diagrams of the Systems MgF_2-MgO and MgF_2-CaO; Transient Measurement of Thermal Diffusivity of Refractory Materials at High Temperature; Emitter Surface Physics of Plasma Diodes; Emitter Sheath Polarity in Plasma Diodes; Investigation of Na–K Seeded Argon Plasma;* and *Transient Concentration Variation in Natural Convection Electrolysis.* Among the research discussed was the formation of simple eutectics in the systems MgF_2–MgO and MgF_2–CaO: 0.085 mol fraction MgO at 1220 ±2° C; 0.075 mol fraction CaO at 1208 ±2° C; and approximately 4.5 wt % Al_2O_3 at 1250° C in the system MgF_2–Al_2O_3. E.E.B.

N65-30905# Atomics International, Canoga Park, Calif.
MINIMUM WEIGHT, SEPARATE-SOURCE PUMP SYSTEM
T. T. Shimazaki 7 Dec. 1964 20 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-TDR-10784)

A method for calculating the minimum weight of a separate source, dc conduction type pump system is presented. Assumed is a square direct radiating converter section which supplies the power to the pump located immediately adjacent to and at the center of this converter. Sample calculations for a pump system capable of pumping 1150° F NaK at a flow rate of 6500 lb/hr against a 1.5 psi head are given. G.G.

N65-30928# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROXIMITY FUZES
A. Sala and S. Przygodzki 12 Jul. 1965 15 p refs Transl. into ENGLISH from Wojskowy Przeglad Lotniczy (Warsaw), no. 5, 1964 p 66–74
(FTD-TT-65-330/1+2+4; AD-467255)

A short outline of the development, construction, and operational principles for the following detection devices is presented: infrared fuses, optical fuses, electrostatic fuses, magnetic fuses, and acoustic fuses. Further development of proximity fuses depends on: (1) utilization of modern electronic elements for construction of fuses; (2) detailed investigation of the targets' physical characteristics for effective construction of the fuses; and (3) utilization of physical phenomena like pressure and nuclear radiation in the construction of new proximity fuses. G.G.

N65-31031*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF SONOTONE CORPORATION 3.0 AMPERE-HOUR TRIPLE SEAL NICKEL CADMIUM CELLS
E. C. Bruess 23 Jul. 1965 12 p
(NASA Order W-11252-B)
(NASA-CR-64353; QE/C-65-512) CFSTI: HC $1.00/MF $0.50 CSCL 10C

Procedures for phenolphthalein leak, capacity, cell short, immersion seal, overcharge, and internal resistance tests are given, and the results are tabulated. Characteristic 2-hour and 48-hour rate discharge curves are included. It is concluded that the triple seal technique, a ceramic seal between two glass to metal seals, is satisfactory. C.T.C.

N65-31058*# Naval Ammunition Depot, Crane, Ind.
[SPACE CELL TEST PROGRAM. LIFE CYCLE TESTS] Monthly Progress Report, Period Ending 31 Jul. 1965
[1965] 147 p
(NASA Order W-11252-B)
(NASA-CR-64349) CFSTI: HC $4.00/MF $1.00 CSCL 10C

Under normal operation, complete data was recorded every 32 cycles on the 90-minute and 3 hour packs. On the 24-hour packs, complete data was taken every eight cycles. Before cycling, each pack was given a capacity test at its respective cycling temperature. This consisted of a c/10 charge for 16 hours followed by a c/2 discharge to 1.0 volt per cell average. After 88 days of cycling, each pack was discharged immediately after the end of the regular cycle period, at the c/2 rate to 1.0 volt per cell average. The pack was then recharged at the c/10 rate for 16 hours and discharged at the c/2 rate to 1.0 volt per cell average. The pack was again recharged at the c/10 rate for 48 hours with voltage being limited to the cycle limits. R.W.H.

N65-31090# Vitro Labs., Silver Spring, Md.
BALLOON INFLATION AND LAUNCHING DEVICE, ML-594 (XE-3)/U Final Report, 1 Jul. 1964–28 Feb. 1965
Dennis L. Mann and R. W. Kelly, Jr. [1965] 12 p
(Contract DA-28-043-AMC-00336(E))
(Rept.-8; AD-616645)

This final report summarizes the approach used to overcome problems associated with the operational and technical tasks assigned for the development of Balloon Inflation and Launching Device ML-594(XE-3)/U. The highlights for the development of a design plan are reviewed. Fabrication of service test devices is discussed for each major subassembly and the rationale of design selections is provided. Principal components that received detailed design description include the canopy, the canopy support, and clamps for securing leg and frame members. Other task assignments are summarized and documentation references are provided. These tasks include visualization data, spare parts list, operator's manual, technical instructions, spare manuals, test plan, environmental testing, compliance report, technical reports, and manufacturer's drawings. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-30215# Joint Publications Research Service, Washington, D. C.
40TH ANNIVERSARY OF THE STATE SCIENTIFIC RESEARCH ROENTGENORADIOLOGICAL INSTITUTE OF THE MINISTRY OF HEALTH RSFSR (1924–1964)
29 Jul. 1965 421 p refs Transl. into ENGLISH of the book "40 Let Gosudarstvennogo Nauchno-Issledovatel'skogo Rentgenoradiologicheskogo Instituta MZ RSFSR (1924–1964)." Moscow, State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR, 1964 p 2–348
(JPRS-31300; TT-65-31797) CFSTI: $7.20

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N65-30216 Joint Publications Research Service, Washington, D. C.
RESEARCH INTO ROENTGENOLUMINOPHORES, X-RAY SCREENS AND PHOTOGRAPHIC MATERIALS
A. M. Gurvich *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 29 Jul. 1965 p 90–95 ref (See N65-30215 19-04) CFSTI: $7.20

The historical development of X-ray screens and photographic materials in the Soviet Union is reviewed. Systematic research into X-ray screens, and particularly the research of a preparative and physicochemical nature, was begun in 1943. Previously, research in this field was confined chiefly to acceptance tests and the development of methods of instrumented studies of the screens and photographic materials. A method of fabricating zinc-cadmium-sulfide screens for roentgenoscopy was developed in 1943. The technology of intensifying screens remained essentially unchanged until

1950 when a new method was developed for obtaining tungstate luminophores. In recent years special attention has been given to studies of the interaction between halogen fusing agents and sulfide in the presence of atmospheric oxygen. Attention has also been paid to the study of tungstate luminophores. The investigations pertained chiefly to the causes of the afterglow of calcium tungstate, the dependence of its properties on the nature of the fusing agent, and the method of luminophore treatment. Research into the characteristics of X-ray screens which determine image quality and the studies of the physical properties of X-ray screens are also discussed. E.E.B.

N65-30217 Joint Publications Research Service, Washington, D. C.
RESEARCH INTO THE DOSIMETRY OF IONIZING RADIATIONS
A. N. Krongauz *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 29 Jul. 1965 p 96–100 (See N65-30215 19-04) CFSTI: $7.20

The history of ionizing radiation dosimetry in the Soviet Union is reviewed. Prior to 1928 no Soviet-made dosimeters were availalbe. With the official establishment of the roentgen as a unit of irradiation dose, an apparatus was built for reproducing the roentgen unit. The development of this ionization chamber laid the foundation for the checkups and calibration of the dosimeters used in the nation's medical institutions, as well as for the further development of Soviet-designed dosimeters. An acceptable model was completed in 1932 which played a major role in the development of dosimetry in the Soviet Union. The principle trend in recent years has been in the physico-dosimetric substantiation of radiation therapy methods. Tables, nomograms, and formulas for calculation of absorbed doses in the presence of interstitial and intracavitary use of radioactive isotopes were developed in 1963. E.E.B.

N65-30218 Joint Publications Research Service, Washington, D. C.
RESEARCH INTO EXPERIMENTAL PATHOLOGY AND BIOLOGY
Ye. D. Savchenko *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 29 Jul. 1965 p 101–109 refs (See N65-30215 19-04) CFSTI: $7.20

The development of research into experimental pathology and biology in the Soviet Union is reviewed. The principal task continues to lie in investigating the biological effect of ionizing radiation on the organism of man and animals, the morphological investigation and comparison of the results produced by applying different methods of radiation therapy to malignant neoplasms, and the determination of the injurious effect of radiation energy on the tissues surrounding the tumor. This is assisted by studies of the sectional material and biopsies, which are performed not only in order to establish the diagnosis and analyze the discrepancies between anatomical and clinico-roentgenological data, but also in order to analyze the subtle structural histological changes that accompany the disease or are a consequence of the effect of ionizing radiation. E.E.B.

N65-30219 Joint Publications Research Service, Washington, D. C.
ROENTGENOTHERAPEUTIC RESEARCH
I. A. Pereslegin *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 29 Jul. 1965 p 110–127 refs (See N65-30215 19-04) CFSTI: $7.20

The development of X-ray therapy in the Soviet Union for the treatment of cancer is reviewed. Malignant skin tumors, cancer of the larynx, primary lung cancer, metastastic lung tumors, esophageal cancer, mediastinum tumors, stomach cancer, rectum cancer, mammary gland cancer, ovary tumors, malignant bone tumors, blood diseases, uterine cervix cancer, and nononcological diseases are included in the historical review of X-ray therapy. E.E.B.

N65-30220 Joint Publications Research Service, Washington, D. C.
RADIOLOGICAL RESEARCH
A. V. Kozlova *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 20 Jul. 1965 p 128–145 refs (See N65-30215 19-04) CFSTI: $7.20

A historical review of radiobiology, dosimetry, and the therapeutic uses of radioactive substances in the Soviet Union is presented. By 1937 the first domestic preparations of radium-mesothorium were obtained, and since 1948 artificial radioactive isotopes in the form of filtered preparations with Co^{60}, P^{32}, I^{131}, Au^{198}, Ag^{111}, and Y^{90} have been available. In the first few years the principal problems pertained to the study of the primary mechanism of action of ionizing radiation and the morphological changes induced by different types of radiation. Later, the principal trend of research became the study of the pathogenosis of radiation injuries and the diagnosis and therapy of the acute and chromic diseases induced by total and local irradiation. The problems and development o safety engineering for the handling of radioactive materials are also reviewed. E.E.B.

N65-30221 Joint Publications Research Service, Washington, D. C.
ROENTGENODIAGNOSTIC RESEARCH
I. A. Shekhter and L. S. Rozenshtraukh *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 29 Jul. 1965 p 146–173 refs (See N65-30215 19-04) CFSTI: $7.20

The history of X-ray diagnostic research in the Soviet Union is presented. The research has been primarily oriented toward investigating the principal problems of clinical practice of Soviet public health. A special place has been occupied by problems of perfecting the methods of the roentgenodiagnosis of different diseases, as well as the development of new, original methods of examination and their introduction into practice. Also, individual roentgenophysiological problems of practical and theoretical importance have been investigated. Roentgenodiagnosis of diseases of the gastro-intestinal tract; roentgenodiagnosis of pulmonary and mediastinal diseases; roentgenodiagnosis of heart diseases, and other roentgenodiagnostic applications are briefly reviewed. E.E.B.

N65-30222 Joint Publications Research Service, Washington, D. C.
RADIODIAGNOSTIC RESEARCH
G. A. Zubovskiy *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 29 Jul. 1965 p 174–176 ref (See N65-30215 19-04) CFSTI: $7.20

A historical review of the diagnosis and therapy of diseases with radioactive isotopes in the Soviet Union is presented. The study of tissue circulation with radioactive sodium; the diagnosis and therapy of the thyroid with radioactive iodine; and the accumulation of radioactive gold in the lymph nodes are considered. The development of radiodiagnostic methods was slow due to the absence of equipment. It was only after the appearance in recent years of modern sensitive scanners, when it became possible to obtain images of organs and tumors, that the methods of radiodiagnosis and particularly of radioscanning began to be rapidly developed. E.E.B.

N65-30223 Joint Publications Research Service, Washington, D. C.

FLUOROGRAPHIC RESEARCH AND THE INSTITUTE'S ROLE IN ITS DEVELOPMENT

Ye. M. Kagan *In its* 40th Anniv. of the State Sci. Res. Roentgenoradiological Inst. of the Min. of Health RSFSR 29 Jul. 1965 p 177–184 refs (See N65-30215 19-04) CFSTI: $7.20

The historical development of fluorographic equipment and methodology in the Soviet Union is presented. The effort toward the designing and improving fluorographic equipment; developing the organizational forms of fluorography; developing methods of the fluorographic examination of different organs and systems and introducing them into medical practice; and the training of skilled physicians and X-ray laboratory workers for work on fluorography is summarized. The further development of fluorography is inseparably tied to improvements in equipment, the use of high-grade gratings and photographic exposure meters, the development of improved general and special purpose fluorographic installations, the use of electron-optical amplifiers of image brightness, motion picture photography, and television. E.E.B.

N65-30265 Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS OF RADIATION BIOGEOCENOLOGY

N. V. Timofeyev-Resovskiy *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 310–356 refs Presented at the Session of the United Sci. Council of the Urals Affiliate, Acad. Sci. USSR, 4 Jan. 1963 (See N65-30250 19-10) CFSTI: $7.00

Experimental findings are presented in the field of radiation biology, and a bibliography relating to problems of biosphere radiation is included. The effect of ionizing radiation on the living organism is discussed for different radiation doses, degree of radiation resistance for different species, and responses of the structures and organisms. Buildup factors for fresh water organisms were investigated, and types of radioisotope distributions were considered. Experimental findings indicate that biocenoses affect the concentration, redistribution, and migration of most of the trace elements investigated. M.W.R.

N65-30345# Milan Univ. (Italy).

DIAPHRAGM ACTIVITY AND THORACOABDOMINAL MECHANICS DURING POSITIVE PRESSURE BREATHING

Technical Report, 1 Feb. 1962–1 Feb. 1963

Emilio Agostoni Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 20 p refs

(Grants AF-EOAR-62-95; PHS RF-15; NATO-RG-30)

(AMRL-TR-64-141; AD-617741)

The electrical activity of the diaphragm and the mechanical contribution of the thorax and the abdomen through the breathing cycle has been investigated in man during positive pressure breathing (PPB). The electrical activity of the diaphragm persists even at values at which inspiration should be completely passive according to the pressure volume diagram of the thorax and lung. The transdiaphragmatic pressure decreases as the value of PPB increases but is still appreciable at values of PPB at which the inspiration appears to be completely passive by an analysis based on transthoracic pressure measurements alone; the transdiaphragmatic pressure becomes zero only at PPB of about 30 cm H_2O. The persistent activity of the diaphragm during PPB is counterbalanced by an activity of the abdominal muscles in excess of that of the expiratory muscles as given by transthoracic pressure measurements. Owing to the persistence of an abdominothoracic pressure gradient, the venous return and therefore the cardiac output should be less reduced than in the case of a passive inspiration. Author

N65-30346# Hine Labs., Inc., San Francisco, Calif.

THE SIMILAR PHARMACOLOGIC AND TOXIC EFFECTS OF PENTABORANE, DECABORANE, AND RESERPINE

Francis W. Weir, Frederick H. Meyers, Robert H. Arbuckle, and Swanson Bennett Wright-Patterson AFB, Ohio, AMRL, May 1965 23 p refs

(Contract AF 33(657)-11756)

(AMRL-TR-65-49; AD-617691)

This investigation was conducted to establish the mechanism of toxic action of pentaborane (B_5H_9) and decaborane ($B_{10}H_{14}$) preliminary to the study of possible therapeutic or protective agents. The pharmacological effects of pentaborane and decaborane on mice, rats, and dogs were studied and compared to the pharmocological effects of reserpine. The compounds were administered intraperitoneally; pentaborane was also administered by the inhalation route. Conscious dogs showed signs of limitation of sympathetic activity, evidenced by miosis, nictitating membrane relaxation, bradycardia, dilation of superficial vessels, and sedation with easy arousal. Anesthetized dogs showed an initial rise in blood pressure followed by hypotension, bradycardia, and decreased response to tyramine. Reversal of some of these effects occurred following norepinephrine infusions. Spectrofluoremetric analyses of the brains of groups of rats administered any of the three compounds demonstrated depletion of serotonin and norepinephrine. Pentaborane is comparatively more active in producing excitement and convulsions. The boranes closely resembly reserpine in their effects but have a shorter duration of action. Author

N65-30369* Harvard Univ., Cambridge, Mass. Museum of Comparative Zoology.

APPLICATION OF SATELLITES OR HIGH-FLYING AIRCRAFT TO STUDIES OF CETACEANS AND OTHER LARGE MARINE ANIMALS

William E. Schevill *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 177–178 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Suggestions are offered for biological tasks, such as studies of cetaceans and other large marine animals, that might be incorporated into the program of a satellite or aircraft designed for other purposes. Attempts have been made to use radio transmitters as tags to trace the migrations of whales in the western North Atlantic; use of satellites or high-flying aircraft could increase the area covered and improve tracking. The most attractive possibility to date is the use of a transponding whale tag, triggered by radar sweeps from an aircraft or satellite and using either sidelooking or PPI radars. For present applications, however, orbiting receivers are not required; any trans-Atlantic flights or suitably instrumented aircraft are adequate. M.W.R.

N65-30381* Sandy Hook Marine Lab., Bureau of Sport Fisheries and Wildlife, Highlands, N. J.

MARINE BIOLOGY AND REMOTE SENSING

John Clark and Richard B. Stone *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 305–312 refs (See N65-30340 19-13) CFSTI: HC $7.45/MF $2.25

Remote sensing from manned orbital spacecraft can be used in marine biology for ecological studies such as measurement of those environmental parameters which most influence distribution, behavior, and abundance of species. Temperature as related to marine fish species and an aerial sea temperature study using an infrared thermometer are discussed. A proposed flight track is illustrated for an infrared survey program in the North Atlantic area which will give more information about the relationship between temperature and

migration of schools. Sea surface isotherms are charted for May 1964; the fish schools indicated were thought to be Atlantic mackerel. Simultaneous recordings from a shipboard infrared thermometer and a towed thermistor are illustrated.
M.W.R.

N65-30448# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODEL OF PARAPSYCHOLOGICAL COMMUNICATION
M. Ryzl 15 Jul. 1965 24 p refs Transl. into ENGLISH from Sdelovaci Technika (Czechoslovakia), no. 8, 1964 p 299–302 (FTD-TT-65-366/1+4; AD-466927)

Three digital numbers (from 000 to 999) were transmitted from one person to another using extrasensual perception (mental telepathy) as the means of telecommunication. The signaled number was coded into sequences of colored cards enclosed in special covers of solid nontransparent material, and handed to the test person until sufficient experimental data was gathered. Analysis of the data indicated that extrasensual perception is applicable as a means of communication. L.S.

N65-30474*# Nevada Univ., Reno.
[AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF LOW PRESSURES ON CELLULAR ULTRASTRUCTURE AND CYTOCHEMISTRY IN PLANTS] Semiannual Progress Report, Nov. 1, 1964–Apr. 1, 1965
Hugh N. Mozingo [1965] 25 p refs
(Grant NsG-464)
(NASA-CR-64097) CFSTI: HC $2.00/MF $0.50 CSCL 06C

Physiological and ultrastructural studies continued on *Avena sativa* to determine the biochemical and biophysical events leading to cytomembrane rupture by exposure to low pressure. Growth chamber experiments were programmed to isolate the environmental factors responsible for a decrease in lethal exposure time to low pressure during the winter. Plants were grown for 16 to 18 days in different cycles and results show that survival time is independent of the photoperiod but dependent on temperature cycle. An experiment was designed to alter cellular permeability by applying decenylsuccinic acid to determine whether a permeability change would affect ultrastructural membrane deterioration under reduced pressure. Acid sprayed prior to exposure to low pressure had no effect on plant survival time. Plants intermittently watered with acid showed a slight increase in ability to resist low pressure effects. Descriptions and results of other investigations are presented and include studies on mineral deficiency, root removal, alcohol determinations, tissue dehydration, and alpine plants. R.N.A.

N65-30480*# Beckman Instruments, Inc., Fullerton, Calif. Special Projects Div.
WEARABLE, WIRELESS OXIMETER Final Progress Report
Robert R. Pintar 11 Jan. 1965 9 p Revised
(Contract NAS2-1362)
(NASA-CR-64080; TM-194) CFSTI: HC $1.00/MF $0.50 CSCL 06L

The oximeter development program was proposed because it was thought that certain improvements, such as the use of interference filters and improved dilation, would overcome many of the difficulties experienced with past ear oximeters. The development was based on the premise that the narrow band optical filters, together with good dilation, would provide accurate results that would be repeatable between individuals. The narrow band optical interference filters would minimize the errors, due to spectral changes in lamp, differences in skin pigments or changes in the absorption characteristics of the blood. Improved dilation would result in a field of view which consisted primarily of arterial blood. This is very important, as the presence of venous blood would cause errors in the output; especially if the relative amounts of venous and arterial blood varied from time to time, or from person to person. The possibility that the device could also be used to make blood pressure measurements was based on the idea that the blood volume in the ear lobe would be a function of the blood pressure. The IR channel of the oximeter would be used for this measurement since this channel responds to blood volume only and, unlike the red channel, does not respond to changes in blood oxygen.
Author

N65-30489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE TEMPERATURE LIMIT OF ARTIFICIALLY COOLING THE ORGANISM OF MAMMALS
K. P. Ivanov and I. P. Pavlov 18 May 1965 7 p refs Transl. into ENGLISH from Priroda (Moscow), no. 8, 1959 p 93–94 (FTD-TT-65-74/1+2; AD-617146)

This report discusses mechanisms involved in supercooling mammals and subsequently restoring them to normal body temperature without physiological damage. A discussion is presented on the experiments performed by R. Andjus who reported that it is possible to artificially cool mammals (white rats) to one or zero degrees centigrade with subsequent restoration of vital functions without altering their normal physiology. An attempt to made to explain the vital mechanism which occurred in the animals during the experiments. A discussion of the physiological activities that occur in hibernating animals is presented. N.E.A.

N65-30496# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
NEW ELECTRONIC INSTRUMENTATION IN DENTISTRY. AN EVALUATION OF MINIATURE CARDIOVASCULAR AND PSYCHOGALVANIC SKIN RESPONSE MONITORING DEVICES
Jack L. Hartley Dec. 1964 12 p refs
(SAM-TR-64-90; AD-460761)

The two instruments evaluated in this clinical study of over 200 patients have been employed and found to be potential aids to the practice of dentistry, establishing better rapport and presenting considerably more information on the physiologic activity of the patient than is routinely available. These instruments did not come between the doctor and his patients; on the contrary, they assisted the doctor in gaining more empathy for the patients, which is essential to successful treatment.
Author

N65-30503# Naval Radiological Defense Lab., San Francisco, Calif.
DOSIMETRY FOR LARGE ANIMAL EXPERIMENTS USING MULTIPLE Co^{60} SOURCES AND 1 MVP X RAYS
Cirel K. Menkes 21 Apr. 1965 23 p refs
(USNRDL-TR-842; AD-464281)

A quadrilateral configuration of four movable uncollimated Co^{60} sources with a total activity of 9000 curies was used to obtain exposure measurements in air and depth doses in a masonite phantom for radiation experiments involving sheep. The depth dose distribution in the phantom in the four source exposure is compared to distributions obtained using a single collimated Co^{60} source four times in succession to simulate the four source array and exposure geometry, and to 1 Mvp X-rays in a bilateral exposure. Distributions of the quadrilateral gamma and X-ray exposures differed quantitatively by no more than 5% throughout the phantom thickness. Ionization measurements were made in outdoor pens built to house one hundred sheep individually during chronic low-level exposures ranging from 500 mR/hr to 4 R/hr. Exposure rates at the two rows of

pens were varied by using several source arrangements. Bilateral depth dose distributions in a sheep phantom exposed in the pens showed that the radiation from the uncollimated sources at the distances of the pens was less penetrating than from a collimated Co^{60} source at a closer distance (corrected for inverse square effect), and more penetrating than from 1 Mvp X-rays except at the phantom surfaces. Author

N65-30506# Chicago Univ., Ill. Air Force Radiation Lab.
STUDIES ON THE RADIOPROTECTIVE ACTION OF SODIUM NITRITE IN MICE
Andrew T. Hasegawa and H. D. Landahl Brooks AFB, Tex., School of Aerospace Med., May 1965 14 p refs
(Contract AF 41(609)-1693)
(SAM-TR-65-13; AD-466469)

Polarographic measurements on the oxygen tension in the spleen and vena cava of mice after injection of 200 mg./kg. of sodium nitrite showed that the oxygen levels decreased to relatively low levels in about 20 minutes. Methylene blue administered at this time protected the mice against nitrite lethality. Methemoglobin concentration and nitrite levels in the blood, plasma, and spleen measured at different times after nitrite injection showed both levels increased with time. Injection of 200 mg./kg. of nitrite 20 minutes before x-ray exposure afforded protection against radiation lethality, the dose-reduction factor being 2.35. Protection was reduced when nitrite-treated mice were irradiated in less than 20 minutes postinjection or when a smaller dose of nitrite was used. This decrease in protection can be correlated with the oxygen-tension values, which were not as low under these conditions. Protection was also reduced when the nitrite-treated mice were irradiated at 1 atmosphere of oxygen, and almost completely eliminated when they were irradiated at 4 atmospheres of oxygen. At 1 atmosphere of oxygen the average spleen oxygen tension was close to normal, but the oxygen tension in the vena cava was low. At 4 atmospheres of oxygen both the spleen and vena cava oxygen-tension values were above normal. Under these conditions, both the methemoglobin concentration and the nitrite level were high, while the protection was low, corresponding to a reduction in dose of 15%. It was found that the relative effectiveness of radiation ($\gamma = 1/DRF$) in all the situations could be calculated from $\gamma = (0.38 + 0.62x)/(1 + 0.15N)$, where N is 1 or 0 depending on the presence or absence of treatment with nitrite; and x, the average of the spleen and vena cava oxygen-tension values, is set equal to 1 whenever it is greater than 1. Author

N65-30534# Northwestern Univ., Evanston, Ill.
AUDITORY FUNCTION OF THE HEARING IMPAIRED
Formal Progress Report No. 1
Tom W. Tillman 15 Jun. 1965 36 p
(Contract AF 41(609)-2643)
(AD-465819)

This report covers progress made on the audiological research project. The work accomplished is summarized in the following sections: (1) personnel; (2) equipment; (3) related activities; (4) results of research; and (5) plans for future investigations. N.E.A.

N65-30567* Tennessee Univ., Memphis. Inst. of Clinical Investigation.
ADDENDUM TO SUMMARY PROGRESS REPORT, 1 AUG. 1962–31 OCT. 1963
Richard H. Overman Mar. 1964 84 p refs
(Contracts AT(40-1)-283; AT(40-1)-1375; AT(40-1)-1642)
(TIP-20979, Addend.)

Certain physiological and biochemical responses of normal and X-irradiated dogs to protracted, induced muscular contraction were studied *in vivo*. The experimental animals were given a single whole-body X-irradiation exposure of 700 or 800 r and increased muscular activity of the hind legs was induced three to four days post-irradiation through stimulation of the sciatic nerve. Tracings of the leg movements were recorded together with observations of blood flow, blood pressure, and analyses of blood and muscle samples. The following differences due to muscular contraction were observed in the irradiated animals: (1) No sodium accumulation and decreased potassium content in the contracting muscle as in normal working muscles, indicating alteration of the ionic transfer mechanism through radiation; (2) a general increased rate of blood flow to the stimulated muscle; (3) significantly higher utilization of muscle phospholipids and increase in muscle water; and (4) reduced cholesterol concentration and elevated potassium content in the liver. G.G.

N65-30572# Institutt for Atomenergi, Kjeller (Norway).
ACTIVATION ANALYSIS OF IODINE IN BIOLOGICAL FLUIDS
J. B. Dahl, O. Johansen, and E. Steinnes Dec. 1964 9 p refs
(KR-80)

A method for activation analysis of iodide in biological fluids has been developed. The method is based on adsorption of iodide on an anion exchange resin, neutron activation of the resin, elution of the induced iodine-128 and separation from other activities by solvent extraction. The method has been used to determine iodide in human urine and is found useful at iodide concentrations down to 0.0004 ppm in volumes not exceeding about 250 ml when applying a flux of about $3 \cdot 10^{12} n/cm^2$ sec. The method is applicable in general for determination of inorganic iodine in aqueous solutions. Author

N65-30597# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.
SURVIVAL OF HIGH-VELOCITY FREE-FALLS IN WATER
Richard G. Snyder Apr. 1965 15 p refs
(AM-65-12)

Forty-four cases of free-falls survived by individuals impacting water environments under conditions of high velocity (50 to 116 ft/sec, corrected for aerodynamic drag) have been intensively investigated and analyzed. Ages varied from 7 to 80 years and the study included 34 males and 10 females. The falls occurred in 17 states, mainly over a 3-year period, and included all known survivals of water impact at over 50 ft/sec. It was found that the most survivable body orientation, by a factor of five to seven, is a feet-first impact in which critical velocity for human survival was approximately 100 ft/sec. No correlation of velocity with degree of injury was found, although distinct patterns of injury were shown. Factors believed to influence human survival tolerances are discussed. Author

N65-30629# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
PROTON ABSORPTION IN DOSE-EQUATED MATERIALS
Technical Report, 1 Sep.–1 Dec. 1964
Joseph F. Janni Apr. 1965 183 p refs
(AFWL-TR-65-3; AD-616703)

This report presents theoretically calculated values of the ionization interaction for protons in numerous materials and compares these values with those of tissue and bone. This has been done so that possible dosimetric media may be compared and evaluated for dose equivalency. Results for the linear energy transfer have also been included. The proton energies are considered from .5 Mev to 1000 Mev. The K and L shell effects upon the stopping power equation have been included. The calculation approach and the resultant tabulations are presented in detail for over seventy different materials. Author

N65-30631# Kansas State Univ., Manhattan. Dept. of Psychology.
SYMPOSIUM ON THE ROLE OF MACROMOLECULES IN COMPLEX BEHAVIOR Final Report
John Gaito [1964] 108 p Symp. held at Kan. State Univ., 20–22 Apr. 1964
(Grant Nonr(G)-00060-64)
(AD-616622)

Several papers on the role of nuclei acids and other macromolecules in complex behavior are presented. The articles include a cellular approach to adaptive processes in the nervous system, a chemically specified molecular mechanism underlying excitation in a nerve, macromolecular conformation changes as possible information processing mechanisms, antibody formation and immunological memory, a review of the role of RNA in information storage in the nervous system, nucleic acids and brain function, RNA and memory, and the structure of memory. R.N.A.

N65-30711# Joint Publications Research Service, Washington, D. C.
TREATMENT OF DISORDERS OF THE NERVOUS SYSTEM BY ELECTRICALLY INDUCED SLEEP
K. O. Ivanov-Muromskiy 2 Aug. 1965 12 p Transl. into ENGLISH from the publ. Splyachyy Mozok (Kiev), 1964 p 64–76
(JPRS-31347; TT-65-31844) CFSTI: $1.00

The history of sleep therapy for disorders of the central nervous system is reviewed, and the use of electricity for producing sleep in the treatment of human injury and sickness is discussed in detail. Also, the use of ultrahigh frequency electromagnetic radiation for the production of sleep is considered. An example is given of 350 patients in different stages of hypertonia treated with electrically-induced sleep. The result was a reduction in arterial pressure, improvement in sleep, and restoration of working capacity in 211 and restoration of working capacity without reduction of blood pressure in 118. The therapeutic effect was insignificant in only 8% of the patients. The therapeutic effect of electrosleep was also clearly manifested in combination with certain medicines. The use of electrosleep for the protection of brain cells against preoperative and postoperative effects is also discussed. The disadvantages and hazards of electrical and electromagnetic therapy are recognized. E.E.B.

N65-30745# Presbyterian-St. Lukes Hospital, Chicago, Ill. Div. of Pathology.
AN EVALUATION OF INTRAVENOUS HYPERTONIC UREA IN EXPERIMENTAL CEREBRAL EDEMA
Raymond A. Clasen, Pauline M. Cooke, Sylvia Pandolfi, George Carnecki, and George Bryar Brooks AFB, Texas, School of Aerospace Med., Jul. 1964 18 p refs
(Contract AF 41(657)-360)
(SAM-TDR-64-18; AD-603052)

Experiments were performed on monkeys to evaluate therapy for alleviating the effects of cerebral hemorrhage and edema. Areas of hemorrhagic necrosis were produced in the brains of monkeys by freezing. Intravenous hypertonic urea was administered 5 hours after injury, and tests were made 1 hour later to determine its effect. The cerebrospinal fluid pressure of the monkeys increased after production of the lesion and decreased after the administration of hypertonic urea. This decrease in pressure was not associated with any chemical evidence of a decrease in edema in the damaged hemisphere but was believed to be the result of dehydration of the undamaged hemisphere. The role of intravenous urea in general neurologic disorders is not well defined, but all the factors of intracranial pathology and physiology should be considered in determining its merits. Author

N65-30826# Bryn Mawr Coll., Pa. Dept. of Biology.
ENZYME INDUCTION AND CORTISONE PROTECTION IN ENDOTOXIN-POISONED MICE AT 25° C COMPARED WITH THAT AT 5° C
L. Joe Berry and Dorothy S. Smythe Fort Wainwright, Alaska, Arctic Aeromed. Lab., Jan. 1965 20 p refs
(Contract AF 41(609)-1764)
(AAL-TDR-64-8; AD-615107)

Mice housed at 25° C are protected by cortisone against endotoxin lethality when the hormone is given at the same time as the poison, but not an hour or two later. This is not true of mice housed at 5° C. Activity of liver tryptophan pyrrolase is lowered by endotoxin and elevated by cortisone only in animals at normal temperatures. R hen endotoxin and hormone are given concurrently, normal enzyme activity is maintained, but activity decreases when the hormone injection is given an hour or more after endotoxin. Actinomycin D, ethionine, 2-thiouracil, and 8-azaguanine (inhibitors of protein synthesis) when given in sublethal amount: potentiate endotoxin, prevent cortisone protection against endotoxin, and block the hormonal induction of tryptophan pyrrolase. Chloramphenicol has none of these effects. Mice infected with *Salmonella typhimurium* have lower than normal tryptophan pyrrolase activity and a smaller induction of enzyme by cortisone 18 hours postinfection than do normal mice or mice 42 hours postinfection. This occurs only at 25° C. Author

N65-30839*# National Academy of Sciences—National Research Council, Washington, D. C.
BIOLOGY AND THE EXPLORATION OF MARS Summary and Conclusions
Apr. 1965 23 p refs
(Contract NASr-239)
(NASA-CR-64337) CFSTI: HC $1.00/MF $0.50 CSCL 06F

The scientific foundations and merits of undertaking a biological exploration of Mars were examined. The origin and nature of life, and the possibility of life on Mars is discussed. Avenues of approach to the exploration of the planet, the timing and strategy of the explorations, and avoiding the contamination of the planet are considered. It is recommended that Mars be explored biologically. L.S.

N65-30840*# Naval Air Development Center, Johnsville, Pa. Aeronautical Computer Lab.
ANALOG POWER SPECTRAL DENSITY ANALYSIS OF ELECTRORETINOGRAM DATA
A. Futterweit and J. G. Dahms 10 Nov. 1964 66 p ref. Sponsored by NASA
(NASA-CR-64330; NADC-AC-6411; AD-455878) CFSTI: HC $3.00/MF $0.75 CSCL 06S

A technique for performing analog power spectral density analyses on physiological data is presented. Electroretinograms (ERG) were made in which the change in voltage between the corneal surface of the eye and a reference location on the head were measured continuously in response to visual stimulation by a contact lens electrode on the eye. The visual stimulation was provided by a regularly flashing light. The ERG's provided a means to measure visual deficit, and an indication of changes in physiological functions which may underlie the visual deficit. The analog techniques used in analyzing the ERG data are described, and power spectral density plots are included for the analog and digital methods. Comparison of the two systems shows close correlation of results, thereby demonstrating the versatility and accuracy of the analog spectral density analysis. R.W.H.

N65-30847*# Northrop Space Labs., Hawthorne, Calif.
INVESTIGATION OF PEROGNATHUS AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY
Progress Report, 1 Apr.–30 Jun. 1965
J. J. Gambino and R. G. Lindberg [1965] 16 p ref
(Contract NASw-812)
(NASA-CR-64315; NSL-64-29-7) CFSTI: HC $1.00/MF $0.50 CSCL 06F

Routine observation data on the reproductive activities of 160 female *Perognathus longimembris* over a 5 month period are reported. Heteromyid breeding techniques resulted in 48 laboratory conceived litters, yielding a total of 158 pocket mice. Observation and selective pairing of females in full estrus with males with enlarged testes resulted in copulation and conception approximately 20% of the time. It was concluded that the reproductive cycles in laboratory maintained pocket mice coincide with the natural breeding season as judged by ecological and field collection data. G.G.

N65-30887# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
THE EFFECT OF 2 MEV X-RAYS ON WHOLE-BODY IRRADIATED PRIMATES. THE RADIATIONS OF SPACE I
Technical Report, 1 Jan.–1 Oct. 1964
Glenn V. Dalrymple, Ian R. Lindsay, and John J. Ghidoni Mar. 1965 27 p refs
(SAM-TR-65-9; AD-466468)

One-hundred four primates (*Macaca mulatta*) were irradiated with graded single exposures of 2 Mev x-rays; and $LD_{50/30}$ of 670 ±20 (S.E.) rads was estimated. Hematologic studies performed over a 90-day postirradiation period revealed no essential difference from previously described results. Serum lactic dehydrogenase (LDH) levels were significantly increased during the first 4 days postirradiation, but they subsequently returned to normal ranges by the 7th day. Levels of alkaline phosphatase and leucine aminopeptidase were unchanged over the 90-day observation period. Clinical changes occurring during the postirradiation period were characteristic of the hematologic death, with the exception of a single animal which died from typical gastrointestinal injury. Examination of tissues obtained post mortem strongly suggests that sepsis was the immediate cause of death. Author

N65-30902# India. Dept. of Atomic Energy, Bombay. Atomic Energy Establishment Trombay.
STRONTIUM-90 CONTENT OF FOOD SAMPLES IN INDIA
Data Summary through 1963
S. J. S. Anand, V. R. Chandrasekaran, S. B. Hingorani, L. U. Joshi, R. N. Khandekar et al Sep. 1964 17 p refs
(AEET-AM-40)

Data are summarized on strontium^{90} in liquid milk samples collected from Bombay and 27 other stations in India, and food grain and vegetable samples collected from various markets in Bombay. The sampling, measurement, and chemical procedures for determining the strontium^{90} content are discussed and the results are tabulated. R.N.A.

N65-30927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTRAOCULAR PRESSURE DURING CHANGING ENVIRONMENTAL PRESSURE IN ANIMAL EXPERIMENTS
E. Marre and N. Tiedt 6 Jul. 1965 21 p refs Transl. into ENGLISH from Arch. Ophthalmol. (Berlin), no. 166, 1964 p 462–474
(FTD-TT-65-307/1+2+4; AD-466561)

An explanation is given of the physiological basis for the relationship between the intraocular pressure and the external pressure. The intraocular pressure was studied in rabbits in connection with spontaneous respiration and in dead animals when the environmental pressure was suddenly lowered or increased. The method, operation, and test arrangement for carrying out the experiment is described, and the mathematical formulation of the transscleral pressure is included. Graphs illustrate the change in the transscleral pressure as a function of the environment pressure in both living and dead animals. Contradictions with other works are discussed along with reasons and possible solutions. Among the conclusions reached are: (1) A linear relationship exists between the environmental pressure and the transscleral pressure. (2) Initial intraocular pressures that are high do not result in any difference in the steepness of the transscleral pressure. (3) The linear relationship is the same in living and dead animals. C.T.C.

N65-30951*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography
Jul. 1965 135 p
(NASA-SP-7011(13)) CSCL 06E

N65-31001# California Univ., Livermore. Lawrence Radiation Lab.
A SCHEMATIC VIEW OF THE ORIGIN OF LIFE
Roger G. Hart 11 Jun. 1965 18 p refs
(Contract W-7405-ENG-48)
(UCRL-14254)

A general scheme is proposed for the origin of life. There are six stages presented: (1) sequence propagation; (2) sequence transcription; (3) dual transcription; (4) the chromosome-messenger; (5) metabolism; and (6) protoplasm. The first four are marked by successive degrees of specialization, which allow the polymers to function more efficiently in their own replication. These stages occur in shallow water, where a variety and abundance of monomer molecules exist in energetic states that favor polymerization. In the last two stages, the supply of activated monomers in free solution was depleted, and the polymers acquired means of obtaining them from other precursors. R.W.H.

N65-31004# Joint Publications Research Service, Washington, D. C.
EFFECT OF ELECTROMAGNETIC RADIATIONS ON LIVING ORGANISMS
A. Presman 10 Aug. 1965 17 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 5, May 1965 p 82–88
(JPRS-31501; TT-65-31997) CFSTI: $1.00

The photosynthesis in plants, the photochemical reactions in man and animals, and the absorption and emission of infrared rays were reviewed. Artificial sources of radiation for treatment in medicine and agriculture were used to stimulate the growth of plants and animals. It was shown that in people who were systematically irradiated with centimeter waves of small intensity, certain physiological functions were disrupted: the heart rate was reduced, the blood pressure dropped, and the nervous system became exhausted. Irradiation with short waves evoked orientational reactions in single-celled organisms. The amoebas stretched out parallel or perpendicular to the electric force lines. The ciliate and flagellate organisms began to move in the direction of the electric force lines. Low-frequency impulses of electric and magnetic fields were observed around the sensory nerve of a frog, and low-frequency magnetic impulses were observed in the vicinity of a human heart. R.W.H.

N65-31022# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
PHYSIOLOGICAL NORMS IN INDIAN ADULTS—DATA ON TOTAL BODY WEIGHT AND WEIGHTS OF TWELVE BODY ORGANS
K. Venkataraman, V. M. Raghunath, K. Santhanam and S. Somasundaram 1964 67 p refs
(AEET(HP)-Th-21)

Data on total body weight and the weights of individual body organs were collected from post-mortem records of about 20 hospitals. Only cases of accidental and instantaneous death were included. In every case taken into consideration, post-mortem examination indicated that the person was in normal health at the time of the accident and that death was caused by the accident. The autopsy was performed within 24 hours following death. The mean weights of total body and individual organs are tabulated. It was observed that there was significant effect on the weights of the organs and total body weight because of the difference in sex, age, and location of the hospital. E.E.B.

N65-31038# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS OF BIOPHYSICS AND PHYSIOLOGY
13 Aug. 1965 27 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 162, no. 3, 1965 p 688–693 (JPRS-31547; TT-65-32043) CFSTI: $1.00

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N65-31039 Joint Publications Research Service, Washington, D. C.
ON THE BIOLOGICAL EFFECTS OF HIGH ENERGY PROTONS
P. P. Saksonov, V. V. Antipov, V. S. Shashkov, B. L. Razgovorov, G. F. Murin et al *In its* Transl. of Biophys. and Physiol. 13 Aug. 1965 p 1–5 refs (See N65-31038 19-04) CFSTI: $1.00

The relative biological effectiveness of protons in comparison with gamma rays was analyzed using various tests characterizing the vital activity and heredity of the cell or organism. The experiments showed that for protons with energies of 660 and 120 MeV, the relative biological effectiveness with respect to DL_{50} for mice and rats was about 0.7. Clinical observations of animals also showed the somewhat lesser effectiveness of protons in comparison with gamma rays. The same results were obtained upon conducting a comparative analysis of chromosomal disturbances in the cells of the bone marrow of mice, in the growth of seeds in higher plants, and in determining recessive sex-associated and dominant lethal mutations in *Drosophila melanogaster*. Tests on mice were conducted to study the radiation protective effect of cystamine dichlorohydrate, aminoethylisothiuronium dihydrobromide (AET), serotonine, creatinsulfate, 5-methoxytriptamine chlorohydrate, triptamine chlorohydrate, and 5-oxytriptophane. The greatest protective effect was found with AET, 5-methoxytriptamine, and serotonine, and the use of these preparations resulted in survival of 50% to 70% of the test animals. E.W.

N65-31040 Joint Publications Research Service, Washington, D. C.
THE EFFECT OF RADIATION PROTECTIVE SUBSTANCES ON THE PROTRACTED AFTERGLOW OR IRRADIATED SOLUTIONS OF SERUM ALBUMIN
I. I. Sapezhinskiy and Yu. V. Silayev *In its* Transl. of Biophys. and Physiol. 13 Aug. 1965 p 6–12 refs (See N65-31038 19-04) CFSTI: $1.00

A serum albumin solution in phosphate buffer was irradiated in a thermostatic vessel in a closed flow system. It was pumped first into a cell located near the photocathode of a photomultiplier and then back into the vessel. The irradiation was performed with a mercury lamp, and the movement of the liquid was set so that the kinetic curves of the protracted part of the afterglow could be recorded. Thirteen compounds with known radioprotective properties were introduced into the system both before and after irradiation. The experimental results are presented in a table. From the table it is evident that compounds possessing pronounced protective properties have the strongest effect on the kinetics of protracted afterglow. These compounds have an even stronger effect when introduced before irradiation. At the same time, compounds exhibiting weakly protective action have little effect on the kinetics of afterglow. E.W.

N65-31041 Joint Publications Research Service, Washington, D. C.
PHYSIOLOGICAL CHARACTERISTICS OF EXCITATION DISTRIBUTION IN THE MUSCULAR SYSTEM DURING CONDITIONED REFLEX CHANGES IN RESPIRATORY GAS EXCHANGE
L. A. Isaakyan, R. P. Ol'nyamskaya, and G. A. Trubitsyna *In its* Transl. of Biophys. and Physiol. 13 Aug. 1965 p 19–23 refs (See N65-31038 19-04) CFSTI: $1.00

The purpose of this investigation was to determine the characteristics of excitation in topographically different muscle groups during conditioned reflex changes of gas exchange in connection with effects of temperature changes and muscular activity. A study was made of the deltoid, the pectoral, the external oblique, and the clavicular-costo-sternal muscles. First an electrophysiological analysis was made of the conditioned reflex changes of general gas exchange in connection with raising dumbells. Similar analysis was made for changes during cooling of the hand and forearm. The data showed that during the formation of a motor conditioned reflex and a heat regulating conditioned reflex there is a varied distribution of the stimulus in topographically different muscle groups. It is concentrated to a great degree in the innervating apparatus of the tonic muscles and is weakly expressed in the phase muscles. E.W.

N65-31053*# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
RESEARCH IN PHOTOSYNTHESIS Quarterly Report No. 8, 6 Mar.–6 Jun. 1965
[1965 17 p refs
(Contract NASw-747)
(NASA-CR-64418) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Investigations on photosynthesis and photosynthetic material are surveyed. Studies are included on chloroplast lipids; lipid synthesis in spinach leaves; photoactivation of photosynthetic reactions in dark stored bean leaves; the action mechanism of manganese in photosystem II; photooxidation of cytochrome c, cytochrome f, and plastocyanin; the reducing power of photoact I; reducing power generated in photosystem II; fluorescence; damaging effects of ultraviolet and strong visible radiation; mass spectrometry; and the identification of the sharp light induced electron spin resonance signal with a photo converter. R.N.A.

N65-31074# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
PHOTOGRAPHIC FILM DOSIMETRY FOR CUTANEOUS BETA THERAPY [DOSIMETRIA CON PELICULA FOTOGRAFICA PARA BETATERAPIA CUTANEA]
Mario de la Vega Vedoya and Mario E. Garcia 1965 8 p refs In SPANISH
(Rept.-155)

The percentage of radiation penetration for strontium^{90}–yttrium^{90}, used in the treatment of mucous and keloid hemoangioma, was determined for various cutaneous levels. Tissue of varying thickness was placed between the radioactive source and a sensitive photographic plate. The optical densities recorded on the plates were used to determine the dosage received for a particular skin thickness. Tables are included which show the percentage of radiation received for skin thicknesses ranging from 0 to 2000 microns. R.N.A.

N65-31081# Hine Labs., Inc., San Francisco, Calif.
FURTHER STUDY OF THE MECHANISM OF ACUTE TOXIC EFFECTS OF 1,1-DIMETHYLHYDRAZINE, METHYLHYDRAZINE, AND 1,2-DIMETHYLHYDRAZINE Technical Report, Sep. 1963–Sep. 1964
Francis W. Weir, Frederick H. Meyers, Robert H. Arbucke, and Jesus H. Nemenzo Wright-Patterson AFB, Ohio, AMRL, May 1965 22 p
(Contract AF 33(657)-11756)
(AMRL-TR-65-48; AD-617692)

Investigations were designed to explore mechanisms of toxic action of SDMH, UDMH, and MMH. The acute toxicity to mice of unbuffered SDMH-dihydrochloride is not different from hydrochloric acid. The tenfold difference between the acute toxicity of SDMH at 24 and 168 hours for mice is not seen in rats or dogs. The degree and time course of liver damage in mice is such that it is probably responsible for the delayed deaths seen in this species. Prophylactic treatment with aminooxyacetic acid provided protection to rats against the lethal effects of UDMH, but not against the effects of MMH. The mechanism and site of action of UDMH (1,1-dimethylhydrazine), MMH (methylhydrazine), and SDMH (1,2-dimethylhydrazine) were investigated. Discrete localized lesions produced in specific areas of the otherwise intact brain stem by suction or electrolytic destruction modify or abolish UDMH-induced convulsions in dogs. The area from which these convulsions arise has been localized to a ventral mid-collicular site. Author

N65-31146*# National Aeronautics and Space Administration. Washington, D. C.
PHARMACOLOGY OF THE CORONARY CIRCULATION
V. N. Kaverina Sep. 1965 209 p refs Transl. into ENGLISH of the book "Farmakologiya Koronarnogo Krovoobrashcheniya" Moscow, Medgiz, 1963
(NASA-TT-F-336) CFSTI: HC $6.00/MF $1.25 CSCL 06O

Pharmacological action on the coronary circulation is reviewed. The investigation is based on published material relating to the effects of pharmacological substances on blood circulation in the heart; information on the physiology of the blood circulation; the results of research on the influence of adrenomimetic, cholinergic, ganglion blocking agents, phenothiazine derivatives, analgesics, nitrites, and nitrates on the cardiac blood vessels; and the data on clinical tests of the new vasodilator chloracizin. The two-phase nature of the action of epinephrine and norepinephrine on the cardiac vessels is reported. Also, acetylcholine and carbachol were found to be capable of dilating the coronary vessels but not of improving the cardiac blood supply owing to hypotonia. The effect of ganglion-blocking agents on blood circulation in the heart depends on the relationship between their influence on the tone of the coronary vessels and blood pressure. Further, the effect of analgesics on the cardiac blood supply is due not to their direct action on the coronary vessels but to their capacity to inhibit the reflexes of these vessels. E.E.B.

N65-31199# RAND Corp., Santa Monica, Calif.
INTRINSIC CONTROL OF BODY FLUID AND ELECTROLYTE DISTRIBUTION AND URINE FORMATION
J. C. De Haven and N. Z. Shapiro Jul. 1965 142 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4609-PR; AD-467099)

Mathematical models are used to examine certain physiological hypotheses that appear to explain some of the ways in which the human body controls fluid and electrolyte distribution over time. Special attention is given to the contribution of renal excretion to this control. A simple model intended to predict compositional changes in the several body compartments is shown and the predictive abilities of larger models that encompass much of the present knowledge of the chemical detail of the body's physiological compartments are described. Various methods are presented for introducing time into these models. R.N.A.

N65-31211# Joint Publications Research Service, Washington, D. C.
THE ROLE OF HEREDITY AND CHROMOSOMAL DISEASES IN ANALYSIS OF THE GENETIC EFFECTS OF RADIATION
Ye. F. Davidenkova and I. I. Shtil'bans 20 Aug. 1965 10 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 9, no. 6, Jun. 1964 p 3–8
(JPRS-31635; TT-65-32130) CFSTI: $1.00

The genetic effects of radiation were studied by calculating the number of chromosomal aberrations in cells of human tissue cultures. Smears of scrapings from oral mucosa, stained with orcein (from children, newborn, and mothers) were used to determine the presence of sex chromatin as a means of diagnosing the Klinefelter's syndrome, the Shereshevsky–Turner syndrome, and the triple-X syndrome, all chromosomal diseases. Down's syndrome, another common chromosomal disease, was also investigated for radiobiological connections. This syndrome is based on an anomalous chromosome set of somatic chromosomes (autosomes). The statistical data indicate that chromosomal diseases are useful in studying radiation genetics. The mother's age, type of abberation, and other factors should be taken in account. L.S.

N65-31213# Joint Publications Research Service, Washington, D. C.
OPTIMAL SELF-ADAPTATION OF METABOLIC PROCESSES IN THE CELL
G. Dechev and A. Moskona 9 Aug. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSR (Moscow), v. 162, no. 2, 1965 p 447–450
(JPRS-31464; TT-65-31960) CFSTI: $1.00

The instantaneous variations of the concentration of metabolites in the system of metabolic processes are determined. Their relations with the Hamiltonian system and pulses are also considered. It is shown that constraints on the control parameters transform the problem of optimization of the system with respect to the given function into a nonclassical variational problem. The solution is given by the theory of optimal systems based on a maximum principle and a closely associated dynamic programming equation. C.T.C.

N65-31233# New Hampshire Univ., Durham.
CHEMICAL SYNTHESES OF ACTINOMYCIN ANALOGS Annual Report, Jun. 1963–Jun. 1964
Robert E. Lyle 15 Mar. 1965 22 p refs
(Grant DA-CML-18-108-61-G28)
(AR-3; AD-616692)

Preliminary pharmacological studies of amino acid derivatives of nicotinic, 4-phenoxathiin carboxylic, and 2-amino-3-oxo-3H-phenoxazine-4,6-dicarboxylic acids are reported. The syntheses of the latter is described. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-30196# Royal Inst. of Tech., Stockholm (Sweden). Speech Transmission Lab.
ACOUSTIC SPECIFICATION OF SPEECH Final Scientific Report (Annual Report, 1964)
C. G. M. Fant 30 Jan. 1965 19 p refs
(Grant AF-EOAR-64-28)
(AFCRL-65-272; AD-615578)

Speech research activities during 1964 centered on studies of speech production and vocal tract characteristics with correlations to speech wave data, and vice versa studies of speech wave data with the underlying physiological structures considered. The predictability of formant patterns through correlation of spectrographic and cineradiographic data was investigated, and a model for speech coarticulation that is tested against cineradiographic data has been proposed. Sine-wave response measurements of the vocal tract transfer functions were used to detail the structure of pole-zero patterns of various sounds and resonance bandwidths. The anatomy of the nasal cavities is reviewed. Also discussed are instrumentation and techniques for inverse-filtering with emphasis on low-frequency noise difficulties and the handling of voice samples with subglottal coupling, as well as the cause of pronounced speech distortions at deep undersea levels. A series-connected terminal analog was successfully employed to synthesize nasal consonants. The motor theory of speech perception is critically evaluated, and some principles of the brain functions are discussed. G.G.

N65-30278# Joint Publications Research Service, Washington, D. C.
CYBERNETIC PRINCIPLES APPLIED IN EDUCATION AND ECONOMICS
26 Jul. 1965 17 p Transl. into ENGLISH from Vestn. Vysshey Shkoly (Moscow), no. 5, May 1965 p 13–25, 87–91
(JPRS-31238; TT-65-31735) CFSTI: $1.00

CONTENTS:

1. USING PROGRESSIVE IDEAS AND METHODS IN TEACHING B. V. Gnedenko p 1–9
2. PROBLEMS OF THE MECHANIZATION OF MANAGEMENT WORK L. G. Petrova p 10–15 (See N65-30279 19-05)

N65-30279 Joint Publications Research Service, Washington, D. C.
PROBLEMS OF THE MECHANIZATION OF MANAGEMENT WORK
L. G. Petrova *In its* Cybernetic Principles Appl. in Educ. and Econ. 26 Jul. 1965 p 10–15 (See N65-30278 19-05)
CFSTI: $1.00

A textbook on the mechanization problems of management in industry is reviewed. The book was written especially for students specializing in the mechanization of accounting and planning enterprises of modern industry. The first part of the book relates to the mechanization and automation of management. It examines the process of algorithmic description and measuring of information. The second section of the book treats the problems of organization, technological normalization, and wages at computer establishments. It is observed that the introduction of modern computing techniques together with modern mathematical methods in the field of managerial work in industry cuts down the cost of manufactured products, increases labor productivity, and the more efficient use of productive capacity. It is noted that the book is written on a high scientific, theoretical and methodical level. Tables are well prepared, showing data obtained from the practice of existing industrial enterprises. E.E.B.

N65-30298# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
ADJUNCT TO SELF-STUDY FOR AIRCREW REFRESHER TRAINING UNDER OPERATIONAL CONDITIONS IN THE AIR DEFENSE COMMAND
Donald E. Meyer Mar. 1965 31 p
(AMRL-TR-65-83; AD-617775)

This is a report of the development and experimental comparison of a self-study technique with conventional classroom methods as a means of refresher training of Air Crews under operational conditions. The self-study technique consisted of: (1) a comprehensive series of multiple-choice questions covering the subject matter with each question bearing reference to the page and paragraph of a manual containing the detailed information on which the question was based, (2) a punchboard by which students immediately determined whether their answer to each question was correct or incorrect, and (3) the manual to which students referred for information when they chose an incorrect answer to a question. The conclusions are: (1) the preparation and administration of the self-study technique is entirely within the capability of an operational squadron with only a minimum of guidance; (2) in the operational setting, the self-study technique is superior to conventional classroom methods in its effectiveness as a means of refresher training; and (3) students favor the self-study method for refresher training. Author

N65-30316 Autometics, Anaheim, Calif.
MANAGEMENT OF THE HUMAN ELEMENT IN THE PHYSICS OF FAILURE
John F. Beau *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 264–279 (See N65-30300 19-09)

A system for better management of the human element in the physics of failure is described. The system provides for the realization by management, quality control, manufacturing, and engineering that failure causing workmanship defect

escapes can be controlled in a routine manner and that such a system is independent of time and personnel changes; allocation of a portion of the reliability budget to escaped workmanship defects and relating it to a quality budget; apportionment of the quality budget to the working level so that workers know what they have to achieve; establishment of a standard for classifying defects in relation to reliability requirements; use of human factors experts to provide assistance; use of an audit system to measure the performance of inspection personnel thereby providing them with knowledge of their performance; and establishment of a practical standard of effectivity for inspection personnel. R.N.A.

N65-30469*# Michigan Univ., Ann Arbor. Office of Research Administration.
[DEVELOPMENT OF ON-LINE MAN–MACHINE SYSTEM PERFORMANCE MEASUREMENT AND DISPLAY TECHNIQUES Letter Progress Report, 1 Mar.–31 May 1965
Robert M. Howe and Richard W. Pew 9 Jul. 1965 34 p refs
(Contract NASr-54(06))
(NASA-CR-64106) CFSTI: HC $2.00/MF $0.50 CSCL 05H

Work is continuing on conduct and analysis of experimental studies of human performance characteristics in manual control tasks and development of facilities and techniques for on-line analysis of human performance data. Experimental studies presented are: (1) Operator Performance in Three-State Relay Control Systems; and (2) Operator Performance with Predictable Input Signals. N.E.A.

N65-30512# System Research, Ltd., Richmond (England).
A STUDY OF GROUP DECISION MAKING AND COMMUNICATION PATTERNS UNDER CONDITIONS OF STRESS AND OVERLOAD, WHEN THE PARTICIPANTS ARE PERMITTED TO FUNCTION AS A SELF-ORGANISING SYSTEM Quarterly Technical Status Report, 1 Jan.–31 Mar. 1965
[1965] 11 p ref
(Contract DA-91-591-EUC-3607)
(QTSR-1; AD-617473)

The effects of stress and overload on group decision making and on communication patterns are discussed. Group system modification to vary the independent subject loading was accomplished by a variable noise facility and the positional cueing facility. Steps were also taken to introduce a third decision maker; a computer program simulating another individual. Third party cueing could double accuracy but is dependent on the individual differences in this role. Investigation of aversive stimuli to increase stress showed that group behavior becomes more erratic with a proficiency decrease of 5%, and with a 20% mean variance increase. The use of aversive stimuli to increase group performance in order to avoid shocks was also studied. This was subject-dependent varying with the equity of the shock received during performance. Probability distribution tables were calculated. W.M.R.

N65-30559# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
FEASIBILITY STUDY OF PERSONNEL IDENTIFICATION BY SIGNATURE VERIFICATION Final Report, 15 Jul.–19 Dec. 1964
A. J. Mauceri Griffiss AFB, N. Y., RADC, Apr. 1965 98 p refs
(Contract AF 30(602)-3493)
(SID-65-24; RADC-TR-65-33; AD-617615)

The Feasibility Study of Personnel Identification by Signature Verification consists of the acquisition of signature samples from test subjects utilizing an instrumented writing device. The signature samples are then analyzed statistically for relatively invariant indices used to establish identity. When these identity patterns are established, the system is capable of differentiating automatically, with a high degree of accuracy, between two or more subjects. The instrumentation of the writing device, establishment of indices, and the analysis program represent the major primary development areas. Author

N65-30630# Bunker-Ramo Corp., Canoga Park, Calif.
HUMAN ENGINEERING SUPPORT: PILOT FACTORS PROGRAM Final Summary Report
21 May 1965 20 p
(Contract AF 33(615)-2214)
(AD-616765)

The report covers the four general activity areas. These areas are characterized by a common plan of approach: (1) technical direction and furnishing of project equipments by the Flight Control Division; (2) installations and maintenance of project equipment by the Lear-Siegler engineering support group; (3) development of instrument flying procedures and inflight conduct of studies by the Instrument Evaluation Section; and (4) development of measurement techniques, data collection, reduction, and analysis by the Bunker-Ramo support group. Each of the four areas is discussed as an entity, with the problems and progress of the individual area placed in context. The appendices contain chronological accounts of presentations to members of the interested flying community, including demonstration flights in PI-FAX aircraft. Author

N65-30632# North American Aviation, Inc., Columbus, Ohio.
IMAGE QUALITY ENHANCEMENT Final Report, Dec. 1962–Feb. 1964
Robert W. Brainard and George N. Ornstein Apr. 1965 63 p refs
(Contract AF 33(616)-7996)
(AMRL-TR-65-28; AD-616895)

A technique for enhancing the quality of imagery was investigated. The technique consists of obtaining a video signal from a transparency and adding to this signal its first and/or second derivative(s). The efficacy of the technique was evaluated by comparing imagery produced by the video signal and its derivative(s) with imagery produced by the video signal alone. The imagery investigated consisted of standard test patterns and aerial photographs. The processed test patterns were quantitatively analyzed to determine the resolution, contrast and acutance of the imagery. The results indicate: (1) differentiation enhances image quality, as indicated by the resolution, contrast and acutance metrics, (2) greatest enhancement is produced by operations which include second-order differentiation, and (3) the least enhancement is produced by first-order differentiation. The aerial photographic imagery shows the same enhancing effects as those obtained with the test patterns. Author

N65-30682# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE LOGICAL SOLUTION TO THE PROBLEM OF DIGIT IDENTIFICATION
A. M. Parachev 6 Aug. 1965 14 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 3, May-Jun. 1965 p 113-123
(JPRS-31440; TT-65-31936) CFSTI: $1.00

A psychological research method using trajectories of a probing hand and reasoning for analyzing processes of recognition is presented. Results of experiments conducted according to this method are cited and the means of constructing a theoretical model of the process of recognition are considered. R.N.A.

N65-30730*# National Aeronautics and Space Administration, Washington, D. C.
COORDINATION OF MAN'S VOLUNTARY MOVEMENTS UNDER SPACE FLIGHT CONDITIONS
L. V. Chkhaidze Aug. 1965 118 p refs Transl. into ENGLISH of the book, "Koordinatsiya Proizvol'nykh Dvizheniy Cheloveka v Usloviyakh Kosmicheskogo Poleta" Moscow, Izd. "Nauka," 1965
(NASA-TT-F-355) CFSTI: HC $4.00/MF $0.75 CSCL 06S

The author presents the problems encountered in movement coordination of man in a changed gravitational field, such as will be experienced in space flights. Simulation of inertial forces occurring in accelerations, as well as flights of manned artificial earth satellites, made it possible to establish the experimental conditions for solving these problems. Author

N65-30853# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Biomedical Lab.
APPLICATION OF GAS EXPANSION TO FLUID CIRCULATION DEVICES IN MANNED SPACE ASSEMBLIES Technical Report, Jun.–Aug. 1964
D. A. Keating Apr. 1965 17 p
(AMRL-TR-65-26; AD-616699)

The power required to circulate fluids for various pressure drops and flow rates, and the power obtained from isentropic expansion of habitable gases for manned space assembly application have been investigated. The results demonstrate the feasibility of using habitable gases, stored under pressure, as potential energy sources to power fluid circulation devices. These findings indicate that significant weight savings can be obtained using the gas expansion technique to furnish the required power of fluid circulation as compared to using other power sources, such as batteries. Author

N65-30920*# Solid State Radiations, Inc., Los Angeles, Calif.
THE DEVELOPMENT OF A PERSONNEL DOSIMETRY SYSTEM FOR APOLLO Eleventh Quarterly Progress Report
H. S. Katzenstein Jan. 1965 19 p
(Contract NASw-415)
(NASA-CR-65071) CFSTI: HC $1.00/MF $0.50 CSCL 06B

A mechanical design and packaging concept was completed for the subminiaturized dosimeter. All circuits were proven in breadboard operation and did not employ components which could not be included in the mechanical design. The effort in circuit design was considered complete, and the remainder of the effort was devoted to completion of the package with performance and environmental testing of the resulting dosimeters. R.W.H.

N65-30921*# Solid State Radiations, Inc., Los Angeles, Calif.
THE DEVELOPMENT OF MEDICAL AND BIOLOGICAL SEMICONDUCTOR DETECTORS Eighth Quarterly Progress Report
F. P. Ziemba Apr. 1964 7 p
(Contract NASw-415)
(NASA-CR-65072) CFSTI: HC $1.00/MF $0.50 CSCL 06B

A prototype dosimeter for manned space flight missions was developed and consisted of such components as: (1) an 8-cubic mm lithium-drifted silicon nuclear particle detector; (2) a low-noise, charge-sensitive preamplifier; and (3) a pulse height integrator employing an electrochemical cell as an integrator. Readout was accomplished by a battery powered readout register that provided direct readout in terms of proton dose in rads. A performance of the unit was verified with 30 MeV protons from the University of Southern California accelerator which qualitatively verified the previously calculated dose calibration. This represented the completion of the breadboard feasibility demonstration phase of the total effort of developing a self-contained, miniaturized dosimeter for space environment. R.W.H.

N65-30934# Bell Helicopter Co., Fort Worth, Tex.
CONTACT ANALOG SIMULATOR EVALUATIONS: ALTITUDE AND GROUNDSPEED JUDGMENTS
Billie A. Abbott and Dora J. Dougherty Mar. 1964 119 p refs
(Contract Nonr-1670(00); Proj. Janair)
(D228-421-015; AD-467203)

This report summarizes work which was accomplished during the first phase of evaluation of the JANAIR vertical display. The purpose of this study was to determine the accuracy with which altitude and groundspeed could be interpreted from the existing display. The display presentation was "open loop" i.e., no control task was required of the experimental subjects. Pertinent applied maneuver variables were presented. These included heading, groundspeed, rate of turn, vertical speed and altitude. The influence of the test variables are discussed. Recommendations are made for use and redesign of this type of display. Author

N65-31008*# National Aeronautics and Space Administration, Manned Spacecraft Center, Cape Canaveral, Fla.
GEMINI LAUNCH VEHICLE PILOT SAFETY PROGRAM-AMR
El Segundo, Calif., Aerospace Corp., 2 Oct. 1963 39 p
Prepared jointly with Aerospace Corp., Revised
(Contract AF 04(695)-169)
(NASA-TM-X-56714; TOR-169(3126)-19; Rev. 1) CFSTI: HC $2.00/MF $0.50 CSCL 05E

The coordination, documentation, procedures, inspections, and responsibilities of the quality assurance program are defined. All aspects of the flight readiness effort are given and include the composition, responsibilities, authority, and activities of the teams involved. The flight safety review procedure is also included. C.T.C.

N65-31050*# Teledyne Systems Corp., Hawthorne, Calif.
RESEARCH IN ADVANCED CONCEPTS IN BIOTECHNOLOGY, HUMAN ANALOGS AND BIONICS First Quarterly Report, 8 Jul.–8 Oct. 1963
[1963] 243 p refs
(Contract NASw-780)
(NASA-CR-64177) CFSTI: HC $6.00/MF $1.50 CSCL 06D

This report describes the human analog of the visual sensor. Analysis of the operation of the human eye was conducted utilizing the framework of the Man-Machine Methodology. An outline of the physiology and anatomy of the eye is presented. Also an outline of the photoreceptor processes is given. It was found that the human analog provided a penetrating insight into the fundamental mechanisms and processes carried out in the eye. Information presented can be directly applied to the design of visual machine extenders that operate on the same principles as the human eye. One advantage that such a bionic device would have is that it could operate over a narrow frequency range after detecting impinging radiation. New and efficient devices that function in the visible, infra-red, ultra-violet or, in fact, in any portion of the electromagnetic spectrum could be built that utilize the fundamental ideas presented in this report on the human analog of the eye. Author

N65-31080# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
KINETIC CUEING IN SIMULATED CARRIER APPROACHES

Joseph N. Ruocco, Patrick A. Vitale, and Robert C. Benfari Port Washington, N. Y., Naval Training Device Center, 28 Apr. 1965 97 p refs
(Contract N61339-1432)
(NAVTRADEVCEN-1432-1; AD-617689)

Pairs of matched pilots were trained using a flight simulator in a carrier-landing maneuver under two conditions—kinetic and static. The two conditions were identical, except that in the kinetic mode cockpit motion was provided. Kinetic cueing significantly improved performance in terms of percentage of successful landings, altitude error, time outside the flight path, and variability of pilot inputs. The statically trained group showed a decrement in performance which persisted throughout training and transferred to the criterion flights which involved cockpit motion. Results clearly indicate that kinetic cueing is a valuable and desirable adjunct to flight airborne simulation systems. Evidence indicates that kinetic cueing serves as a general alerter rather than as a source of specific information for the pilot. Author

N65-31179*# Martin Co., Baltimore, Md.
DESIGN STUDY FOR LUNAR EXPLORATION HAND TOOLS First Quarterly Report
Donald S. Crouch Jan. 1965 36 p refs
(Contract NAS9-3647)
(NASA-CR-65092; ER-13766) CFSTI: HC $2.00/MF $0.50 CSCL 05E

The purpose of this report is to present the results of the first three months work performed for the Design Study of Lunar Exploration Hand Tools. A review of current authoritative interpretations of lunar surface geology and environment was conducted and the need for a portable, battery-powered specimen sampling tool was established. Preliminary lunar gravity simulator tests were performed to define the optimum size for the power tool. Basic design criteria were established, a battery power pack was selected, motor and mechanism approaches were determined, and an integrated configuration envelope was defined. Author

N65-31185*# Beckman Instruments, Inc., Fullerton, Calif. Scientific and Process Instruments Div.
ELECTROENCEPHALOGRAPH SIGNAL CONDITIONERS Final Report
23 Apr. 1965 68 p ref
(Contract NAS9-3456)
(NASA-CR-65099) CFSTI: HC $3.00/MF $0.75 CSCL 06B

Electroencephalograph signal conditioner systems intended to perform during spacecraft launch, orbit, reentry, and impact are described. In addition to the physical and electrical specifications for the equipment, the performance requirements are detailed for numerous environmental conditions. Analytical discussions of common mode rejection and recovery time are given. Signal conditioners met all test specifications during high temperature, salt spray, pressure, oxygen atmosphere, acceleration, sand and dust, acoustic noise, shock, and endurance tests. The difficulties encountered in electrical interference, low temperature, humidity, immersion, and vibration tests are discussed along with the adjustments made to satisfy the project requirements. J.M.D.

N65-31206# Stanford Research Inst., Menlo Park, Calif.
EXPLORATIONS IN THE AUTOMATION OF SENSORIMOTOR SKILL TRAINING
Douglas C. Engelbart and Philip H. Sorensen Port Washington, N. Y., Naval Training Device Center, May 1965 83 p refs
(Contract N61339-1517)
(NAVTRADEVCEN-1517-1; AD-619046)

Some problems of automating sensorimotor skill training were explored with a system served by a CDC 160-A computer. *Ss* were trained to transmit 31 alphanumeric characters on 5-key chord keysets. Training conditions varied response prompting (cueing) and confirmation (feedback). Prompting stimuli were (1) lights (automated visual), (2) air jets (automated tactile), (3) reference sheets (nonautomated). Some *Ss* received feedback; others received none. Discriminability of automated prompts were also compared. Throughout experimentation, the computer controlled all presentations and recorded individual performance. No reliable group differences were found in terminal speed or accuracy among groups trained under different prompting conditions. The group trained with tactile prompts was least variable in response speed but most variable in response accuracy. Feedback signals aided code learning regardless of prompting. Discrimination tests favored visual over tactile prompts; tactile stimuli were difficult for most *Ss* to discriminate. Author

N65-31241# California State Polytechnic Coll., San Luis Obispo.
THE HUMAN BLACK BOX. A LITERATURE SURVEY OF BIOCONTROL DATA
Alexander N. Landyshev 25 Aug. 1965 22 p refs

Reference data on human behavior in engineering terms are presented. Methods are discussed for combining and correlating three phases of the human being and the human operator data; actions, reactions, and responses. Human factors in engineering, electrical engineering, biomedicine, biocontrol, and bioelectronics are also discussed. R.W.H.

N65-31242# Bio-Dynamics, Inc., Cambridge, Mass.
DESIGN AND USE OF INFORMATION SYSTEMS FOR AUTOMATED ON-THE-JOB TRAINING. VOL. III: EXPERIMENTAL USE OF THREE INSTRUCTIONAL CONCEPTS
Thomas B. Sheridan Bedford, Mass., AFSC, Electron. Systems Div., Mar. 1965 85 p refs
(Contract AF 19(628)-455)
(ESD-TDR-64-234, Vol. III; AD-616544)

The report describes three experiments in which novel teaching concepts were demonstrated. These concepts had been proposed in previous reports but their effectiveness remained to be verified experimentally. The results were: (1) A teaching program ordered according to the discovery principle significantly reduced errors and performance time over that observed after training with a conventional training manual. (2) Slides projected directly onto a control console, together with a taped lecture, were found to be an effective method of presenting an automated training program. (3) Graphical logical flow diagrams were found to be efficient instructions for teaching procedures for performing a querying-reasoning task. Author

N65-31249# Bio-Dynamics, Inc., Cambridge, Mass.
DESIGN AND USE OF INFORMATION SYSTEMS FOR AUTOMATED ON-THE-JOB TRAINING, VOLUME V Final Report
Thomas B. Sheridan Bedford, Mass., AFSC, Electron. Systems Div., Apr. 1965 22 p refs
(Contract AF 19(628)-455)
(ESD-TDR-64-234; AD-616545)

This report describes the results and conclusions of a study which was directed at the development of principles for the design of automated instructional subsystems for Information Systems. A series of four Technical Documentary Reports have been issued which describe in detail the activities and results of each aspect of the study. This report brings together and summarizes the results reported in the individual

documents, and includes additional items which did not warrant separate documentation. Author

06 CHEMISTRY

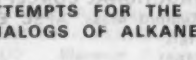
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-30212 Library of Congress, Washington, D. C. Aerospace Technology Div.
TITANIUM-CONTAINING SEMIORGANIC POLYMERS
Boris Nartsissov *In its* Foreign Sci. Bull., Vol. 1, No. 7 Jul. 1965 p 19-26 refs (See N65-30207 19-34)

The synthesis of some new titanium-containing polymers is described. The first part of this report discusses titanium- and phosphorus-containing polymers of two types: (1) titanoxane backbones fringed with phosphonyl or phosphinyl radicals, and (2) Ti-O-P type backbones. In the second part, titanium-silicone polymers with regular network structure are described and their thermal and electric properties are discussed. The studies were conducted at the Institute of Heteroorganic Compounds of the Academy of Sciences USSR under the guidance of Academician A. K. Andrianov, a renown scientist in the field of silicones and other semiorganic polymers. The studies mentioned in part 2 were carried out jointly by several scientific institutes, including the All-Union Electrotechnical Institute im. V. I. Lenin (VEI) Author

N65-30245# Cincinnati Univ., Ohio. Dept. of Chemistry.
SYNTHETIC ATTEMPTS FOR THE PREPARATION OF NITROGEN ANALOGS OF ALKANES AND ALKENES Final Report
Hans Zimmer [1965] 7 p refs
(Contracts DA-33-008-ORD-1757; DA-33-008-ORD-1971)
(AROD-2276-10; AD-617274)

This research is concerned with new synthetic methods to obtain compounds containing a $\geq N-N\leq$ bond as well as the hitherto virtually unknown class of triazanes; these are compounds having three nitrogen atoms linked together by two single bonds and attached to carbon atoms also by single bonds only;



The results and conclusions from the research are presented. N.E.A.

N65-30264 Joint Publications Research Service, Washington, D. C.
DETERMINING THE SEQUENCE OF BASES IN THE BIOCHEMICAL CODE. II: THE PRINCIPLE OF THE CONNECTEDNESS OF SERIES
V. A. Ratner *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 283-309 refs (See N65-30250 19-10) CFSTI: $7.00

Connectedness, a common feature of the biochemical code, is formulated as a hypothesis which states that each series of equivalent codons originated through evolution from some single codon by means of simple mutations. The derivation of a code scheme (based on all known and presumed codons, mutations, forks, recombinations, and the principle of the connectedness of series) leads to three variants of the sequence of bases in the codons. These are designated as A2, A3', and A3''; and A3 is the least contradictory and satisfies the principle of the connectedness of series. Additional codons are proposed to account for mutations and to insure connectedness. Mutations in tobacco mosaic virus and hemoglobin are among those considered, and Girer octets with amino acids are illustrated for each of the variants. M.W.R.

N65-30273# Royal Inst. of Tech., Stockholm (Sweden). Physics Dept.
DISSOCIATION OF METHYLAMINE MOLECULE IONS FORMED IN CHARGE EXCHANGE COLLISIONS WITH POSITIVE IONS Scientific Report No. 1
H. Sjögren 25 Mar. 1965 19 p refs
(Contract AF 61(052)-762)
(AFCRL-65-423; AD-617347)

Mass spectra of methylamine have been obtained after charge exchange with slow positive ions, and the intensities of the peaks have been plotted as a function of the energy absorbed by the molecule during the charge exchange. The curves are integrated to give the electron impact mass spectrum, which is compared with experimental values. A region with low probability for ionization seems to exist between 11 and 12 eV. The structure and dissociation of methylamine are discussed. Author

N65-30274# Army Electronics Labs., Fort Monmouth, N. J.
COMPARISON OF SOME PHYSICAL AND CHEMICAL PROPERTIES OF VACUUM EVAPORATED AND SPUTTERED NICKEL–CHROMIUM FILMS
I. H. Pratt, W. Weintraub, and W. Wade Apr. 1965 29 p refs
(ECOM-2582; AD-617253)

Thin films of nickel-chromium were deposited on planar glass substrates by vacuum evaporation and sputtering processes. The alloy "Nichrome V" with a bulk composition Ni 80% Cr 20% was evaporated from a tungsten filament and used as the cathode in the sputtering process. The composition ratio, sheet resistivity, thickness, film density and temperature coefficient of resistance were investigated or derived for each process and compared. Under constant deposition conditions the vacuum evaporated films indicate a variation of composition ratio with sheet resistivity whereas for sputtered films the ratio tends to remain more nearly constant over an extended range of sheet resistivities. The temperature coefficient of resistance varied with the sheet resistivity from positive to negative for the evaporated films whereas for the sputtered films the coefficient remains positive over an extended range of sheet resistivities. Author

N65-30276 Joint Publications Research Service, Washington, D. C.
ETHYLENE-PROPYLENE COPOLYMERIZATION AND ETHYL-PROPYL RUBBER
Wei-K'o Chiao *In its* Transl. on Communist China's Sci. and Technol., No. 198 26 Jul. 1965 p 46-81 refs Transl. into ENGLISH from Hua-hsueh T'ung-Pao, (Peking), no. 4, Apr 1965 p 1-9 (See N65-30275 19-34) CFSTI: $3.00

Recent literature on ethylene-propylene polymers is reviewed. Various catalysis systems for producing ethylene-propylene copolymers of disordered sequence are discussed in detail, as well as factors that affect the composition of the copolymers and the copolymerization rates. Analytical summary is also presented on the vulcanization of ethyl-propyl rubber by use of peroxides and polyhalides, actor groups, or double bonds. Ethyl-propyl rubber is the first copolymer of significant value since the development of Ziegler catalysts, but the related copolymerization theory and vulcanization chemistry have not been fully investigated. J.M.D.

N65-30277 Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF DIALKYL ESTER PHOSPHITES

Chi-ying Ts'ai and Kuei-lin Ch'en *In its* Transl. on Communist China's Sci. and Technol., No. 198 26 Jul. 1965 p 80–81 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao, (Peking), no. 11, 1964 p 1003 (See N65-30275 19-34) CFSTI: $3.00

Phosphorus trichloride was used in synthesizing dialkyl ester phosphites, and high yields were obtained. In separate experiments, phosphorus trichloride was tested with equivalent weight of methyl alcohol containing water, in the presence of benzene; with ethyl containing water, in the presence of petroleum ether; and with water containing propyl and isopropyl alcohols, in the presence of petroleum ether. J.M.D.

N65-30324 United Aircraft Corp., Norwalk, Conn. Norden Div.

RADIOACTIVE TRACERS IN SEMICONDUCTORS

William Salmre, Ralph Gorman, and Carlos Figueroa *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 378–388 refs (See N65-30300 19-09)

It is often difficult to attribute failures in semiconductors (other than simple mechanical or electrical ones) to any certain causes. Yet, it appears that this class of failures is caused by migration of certain trace chemical species or, perhaps, by imperfections in the crystal or oxide structures or by combinations of these mechanisms. Since the number of atoms or molecules responsible for a failure need not be very large, radioactive tracers offer a general method for studying these kinds of failures. Thus far, the amount of residue left behind the radioactively tagged $C^{14}H_3OH$, $H_2S^{35}O_4$, $NaCr^{51}O_4$ and HCl^{36} has been investigated. Silicon slices were thermally oxidized with steam, a solution containing the radioactive chemical was applied, and the slices were processed through steps similar to those used in the manufacture of integrated circuits. Residual radioactivity was measured after each process step. It was found that certain chemical cleaning treatments of the slices are more effective in the removal of the radioactive residues than others. One of the most effective treatments for the removal of impurities seems to be an immersion in HF. Author

N65-30416 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COURSE OF REACTION IN DETONATION WAVE OF EXPLOSIVE MIXTURES

A. Ya. Apin, I. M. Voskoboynikov, and G. S. Sosnova *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 179–184 ref (See N65-30400 19-23)

The reaction kinetics of shock waves is discussed. Detonation velocities and pressure distributions are considered for several explosives. During the investigation of liquid explosive solutions, it was discovered that a strong dependence of detonation velocity on charge diameter existed although this relation was completely absent for the individual liquid and single crystal explosives. This phenomenon was observed with solutions of tetranitromethane with nitrobenzene and kerosene. E.E.B.

N65-30435 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF KINETICS OF OXIDATION OF LIQUID ALUMINUM

A. Ya. Radin *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 81–111 refs (See N65-30431 19-17)

The kinetics of oxidation of liquid aluminum in air was studied at temperatures from 680° to 900° C. After two to three hours of exposure, it was shown that oxidation follows the parabolic time law. Also, at these temperatures the constant of rate dependence is expressed by a straight line. Calculations of the coefficients of time and temperature laws of oxidation, entropy, and free activation energy allowed an estimate of the oxidizability of liquid Al depending on the temperature and duration of heating in air. Fixed regularities of the oxidation of liquid metals were observed, and various conclusions were deduced. It was shown that oxide film on the surface of liquid Al posseses high protective stability when compared to other metals. C.T.C.

N65-30436 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF KINETICS OF OXIDATION OF ALUMINUM ALLOYS IN LIQUID STATE

A. Ya. Radin *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 112–138 refs (See N65-30431 19-17)

Investigations on the oxidation of liquid aluminum and its alloys showed that, as a rule, oxidation is influenced by elements of the alloy less noble than aluminum. Equations are given for estimating the possible oxidation of the alloying element at a given temperature, and for determining minimum concentration of the alloying component in the alloy. Among the conclusions reached are that oxidation of alloys follows a parabolic time law; sodium can render negative influence on oxidizability of aluminum and its alloys; and oxidation of an alloy significantly increases with an increase in magnesium content. C.T.C.

N65-30438 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF CONTENT OF HYDROGEN IN ALUMINUM ALLOYS BY METHOD OF VACUUM EXTRACTION

A. P. Gudchenko and A. I. Leont'yev *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 160–186 refs (See N65-30431 19-17)

Improvements in the design of a high vacuum installation for the determination of hydrogen content in light alloys, and the development of a determination method are described. The installation consists of 12-mm internal diameter glass tubes with the whole system assembled on a metal frame. The extracting part of the system consists of a heater, retort, loading attachment, and mercury pumps. The analyzing part includes an oxidizing device, two traps for cold-treating water vapors, two compression manometers, a vacuum gauge thermocouple tube, and mercury seals. The method developed for carrying out the experiments consisted of: (1) preparation of installation for operation; (2) determination of correction of control experiment; (3) extraction of gases from samples; and (4) analysis of gases for hydrogen content, and counting quantity of extracted gases. Data are graphically presented, and it was concluded that use of this method resulted in higher accuracy. C.T.C.

N65-30439 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF CONTENT OF HYDROGEN IN MAGNESIUM

A. P. Gudchenko and V. V. Serebryakov *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 187–199 refs (See N65-30431 19-17)

Different methods of determining the amount of hydrogen in magnesium are given, and the results are tabulated. Comparisons are made between the various methods, and some of the obstacles encountered are discussed along with solutions to the problems. The method of hot vaccum extraction is described in detail. Graphs are included, and comparisons with other methods show that hot vacuum extraction is also an exact method. C.T.C.

N65-30456*# Nuclide Corp., State College, Pa.
IBM FORTRAN PROGRAM FOR THE CALCULATION OF CIPW IGNEOUS ROCK NORMS
Peter Deines 1 Jun. 1965 20 p refs
(Contract NASw-1062)
(NASA-CR-64200; TR-65-09) CSCL 07B

An IBM Fortran computer program was designed to calculate the normative composition of igneous rocks from chemical analyses containing up to 23 elements. The program printout consists of self-explanatory headings and sample identification; a list and sum of oxides used in the computation; the weight percent and sum of the 12 salic and 19 femic normative minerals; and the molecular ratio of MgO to FeO in hypersthene, diopside, and olivine as calculated. Carbon dioxide appearing in a given chemical analysis may be recalculated either as sodium carbonate or as calcite. A flow chart indicating the sequence of computation for all possible conditions is presented. R.N.A.

N65-30473*# California Univ., Berkeley. Space Sciences Lab.
DYNAMIC BEHAVIOR OF POROUS ELECTRODE SYSTEMS Final Report
Richard C. Alkire, Edward A. Grens, II, Rolf H. Muller, and Charles W. Tobias 24 Jun. 1965 78 p refs *Its* Ser. No. 6, Issue No. 22
(Grant NsG-150-61)
(NASA-CR-64108) CFSTI: HC $3.00/MF $0.50 CSCL 07D

Research was conducted to formulate an improved theoretical model for flooded porous electrodes under dynamic and static conditions, and to develop experimental methods for measuring reaction distribution in electrodes with small pore dimensions. A mathematical model was derived which treats transient and steady state operation of flooded porous electrodes where no changes occur in the properties of the electric matrix during operation. Computer implemented computational procedures for prediction of electrode performance were developed based on this model. Three approaches to reaction distribution measurement are included. A segmented porous electrode to stacked porous lamina was used in the first but difficulties in electrode fabrication restricted its application. In the second, a single pore in the form of micro-fissure with segmented walls was employed with a redox electrode reaction. Current distributions for a range of pore sizes were measured in this manner. In the last, porous metal electrodes were dissolved anodically under controlled conditions with current distribution determined by post electrolysis photomicrographic examination. This approach shows the most potential. R.N.A.

N65-30487*# Naval Research Lab., Washington, D. C.
HIGH TEMPERATURE PROPERTIES OF SODIUM, POTASSIUM, AND CESIUM Thirteenth Progress Report
J. P. Stone, C. T. Ewing, J. R. Spann, and R. R. Miller 15 Jan. 1965 4 p refs
(Contract NAS-C-76320)
(NASA-CR-64221; NRL-6213) CFSTI: HC $1.00/MF $0.50 CSCL 07D

An experimental program to measure various thermophysical properties of sodium, potassium, cesium, and their vapors at elevated temperatures has been completed at NRL. Preliminary data for the density of liquid potassium (1099° to 2287° F) and the vapor pressure of cesium (1214° to 2345° F) are presented in this report. Author

N65-30499# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-TEMPERATURE RESISTANT HIGH POLYMERS
J. Techel 14 Jul. 1965 17 p refs Transl. into ENGLISH from Plaste und Kautshuk (Leipzig), v. 10, no. 3, 1963 p 137-140
(FTD-TT-65-354/1+2+4; AD-466925)

The field of high temperature resistant plastics and rubber, plastic materials and processing products of elastomers, is reviewed. Particular topics are comparison of various methods for determining heat resistance, methods for increasing the high temperature resistance of polymers after the materials are developed, and means of increasing the softening point of polymers. J.M.D.

N65-30537*# Sperry Rand Research Center, Sudbury, Mass.
DEVELOPMENT OF CHEMICAL ANALYSIS TECHNIQUES FOR ADVANCED MATERIALS RESEARCH PROGRAM Quarterly Progress Report No. 1, 1 Dec. 1964–28 Feb. 1965
Frederic D. Leipziger [1965] 15 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950992)
(NASA-CR-64230; SRRC-RR-65-21) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Existing analytical methods, such as emission and mass spectrography, vacuum fusion, hot extraction, and combustion techniques were evaluated for their sensitivity, accuracy, applicability, size of sample required, and element coverage. The status of the methods is tabulated for refractory metals, metal carbides, and metal oxides. These methods were then applied to analyzing the chemical states of the interstitial elements, hydrogen, nitrogen, oxygen, and carbon. The result of mass spectrographic analyses on tungsten are also included in tabular form. L.S.

N65-30538*# Sperry Rand Research Center, Sudbury, Mass.
DEVELOPMENT OF CHEMICAL ANALYSIS TECHNIQUES FOR ADVANCED MATERIALS RESEARCH PROGRAM Second Quarterly Progress Report, Mar. 1–May 31, 1965
Fredric D. Leipziger [1965] 15 p Prepared for JPL
(Contracts NAS7-100; JPL-950992)
(NASA-CR-64231; SRRC-RR-65-44) CFSTI: HC $1.00/MF $0.50 CSCL 07B

The past three months of the study, aimed at the development of reliable analytical techniques, have been devoted almost exclusively to mass spectrographic analysis. A great deal of effort has been expanded during the report period in an attempt to use mass spectrographic techniques for the analysis of nonconductors, such as MgO, and for the analysis of gases. In order to evaluate the effectiveness of these procedures, standard samples and techniques to check mass spectrographic results have been used. Standard refractory oxide materials which are certified for gas content were not found, but metal standards from NBS which contain known amounts of nitrogen, oxygen, and carbon were obtained. These have been run successfully. The emission spectrograph is being used as a check method for imputity analyses. Preliminary results are presented. The one analysis which apparently cannot be handled satisfactorily by the mass spectrograph is that for hydrogen. Numerous attempts have been made to analyze both metals and nonconductors for hydrogen content, but the results do not appear reliable. The most probable cause of trouble is in the instrument. N.E.A.

N65-30561*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
STUDY OF THE EFFECTS OF ETHYLENE OXIDE–FREON 12 UPON PROPERTIES OF POLYMERS AND METALLIC SURFACES Interim Status Report, 1 Oct. 1964–30 Apr. 1965

R. F. Rydelek and A. L. Landis [1965] 40 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951003)
(NASA-CR-64275; P65-57) CFSTI: HC $2.00/MF $0.50 CSCL 07A

As effective in-depth sterilization of spacecraft will require exposure of components and systems to heat as well as sterilizing gas, the primary object of this program is to provide quantitative information on the compatibility of polymeric and metallic materials with such methods. Silicone and epoxy compounds were subjected to a dry heat cycle before and after exposure to a 12% ethylene oxide–88% Freon 12 gas mixture. Changes in physical, mechanical, and electrical properties were measured, and a concurrent study of the nature of gas-material interactions was made. Of the materials tested, none has displayed sufficient degradation to classify it as incompatible with the sterilizing regimes used. E.W.

N65-30566# Texaco Experiment, Inc., Richmond Va.
INVESTIGATION OF THE DISSOCIATION CHEMISTRY OF NF_2 COMPOUNDS Quarterly Progress Report, Aug.–Oct. 1964
P. L. Goodfriend and H. P. Woods 1 Nov. 1964 12 p refs
(Contract Nonr-1883(00))
(EXP-452; TM-1602)

During this report quarter, work has proceeded in two areas: A. Flash photolysis—kinetic spectroscopy studies designed to find an electronic absorption spectrum due to the NF radical for use in kinetic studies. B. The study of the emission spectrum of the NF_3-H_2 diffusion flame with the object of searching for an electronic emission spectrum for the NF radical, and also because of its intrinsic pertinence to the study of the decomposition chemistry of NF_2 compounds. In the first area, it has been concluded that further attempts to find the NF spectrum, using NF_2 as the starting material, is not worthwhile and attention has been shifted to FN_3. In the second area, the emission spectrum of the flame has been obtained. One band and several features have not as yet been assigned and may be previously unreported spectra. In other aspects, the emission is similar to that of the NH_3-F_2 flame with only a few differences. Author

N65-30571# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
A TABULATION OF THE SPECIFIC HEAT CONTRIBUTION DUE TO THERMAL EXCITATION (SCHOTTKY EFFECT) OF THE 4F ELECTRONS OF SOME DI- AND TRI-VALENT LANTHANIDE ELEMENTS
David H. Dennison and Karl A. Gschneidner, Jr. May 1965 41 p refs
(Contract W-7405-ENG-82)
(IS-1156) CFSTI: $2.00

The 4f electronic specific heat contribution for divalent samarium and for the trivalent lanthanide elements Ce, Pr, Nd, Pm, Sm, Eu, Tb, Dy, Ho, Er, Tm and Yb has been calculated and is tabulated at 25° K intervals from 50° to 200° K, at 50° K intervals from 200° to 400° K, and at 100° K intervals from 400° to 2000° K. Author

N65-30605 Atomic Energy Commission, Washington, D. C.
REACTIVITY OF DIFFUSION OF CARBON INTO TUNGSTEN
G. S. Kreimer, L. D. Efros, and E. A. Voronkova 1964 16 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 22, 1952 p 858–883
(AEC-TR-6510)

Reactive diffusion phases of carbon into tungsten rods under exposure to a hydrogen stream of 1500° to 1800° C for 30 minutes to 24 hours duration were studied by microscopic observation of the rod sections, measurements of the diffusion layer, and X-ray of the carbonized samples. It was found that: (1) carbon diffuses inwardly into the tungsten through phase WC and forming W_2C; (2) the isothermal growth of W_2C is not dependent on carbon concentration; (3) the activation value of $D(C_1 - C_2)$ for a layer of W_2C can be expressed by the equation

$$D(C_1 - C_2) = 2750e^{\frac{-56,000}{T}} \text{ gm/cm per second;}$$

(4) the diffusion value equation of Dushmann–Langmuir to a given complex case is hetro-diffusion; (5) the carbonization of carbon occurs generally through chemical reaction of the tungsten surface with a gaseous media independent of the presence of solid carbon; and (6) the diffusion of carbon along grain boundaries does not predominate over bulk diffusion and occurs primarily along free surfaces. G.G.

N65-30611# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
SEMIWORKS EVALUATION OF THE MANGANESE DIOXIDE HEAD-END STEP IN THE THOREX PROCESS
Albert A. Kishbaugh Jul. 1965 13 p ref
(Contract AT(07-2)-1)
(DP-982) CFSTI: $1.00

The standard Savannah River Plant procedure for precipitating MnO_2 as a head-end step in the Purex process is satisfactory for sorption of protactinium in the dilute Thorex process at rates of ~4000 lb Th/day with the following modifications: (1) sulfamic acid is added to the dissolver solution to decompose nitrous acid, which would otherwise dissolve some of the MnO_2, (2) residual liquid skimmed from the centrifuge is recycled, and (3) the volume of dilute acid used in each of the five washes of the MnO_2 precipitate is doubled to 50 gallons. Author

N65-30617# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
THE PREPARATION OF RADIOACTIVE PHOSPHORUS-32 SOURCES ON METAL PLATES
W. C. Dietrich and R. E. Barringer 4 Aug. 1965 16 p
(Contract W-7405-ENG-26)
(Y-1484) CFSTI: $1.00

A technique was developed for adhering phosphorous-32 to a tantalum or aluminum metal supporting plate. An aqueous radioactive solution was incorporated into a proprietary cement thinner (Sauereisen 14) and a measured quantity deposited on a metal plate. After drying and baking thoroughly, a uniform, hard, and tenacious radioactive source was produced. Author

N65-30647# European Atomic Energy Community, Brussels (Belgium).
OXYGEN AND HYDROGEN ELECTRODES IN MOLTEN FLUORIDES
S. Pizzini, R. Morlotti, and G. Sternheim 1965 16 p refs Presented at 15th Meeting of the Intern. Comm. of Electrochem. Thermodyn. and Kinet., London, 20–26 Sep. 1964
(EUR-2249.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

Overvoltage measurements in the molten LiF-NaF-KF eutectic mixture, containing oxides hydroxides and water in solution, were carried out by the galvanostatic single-pulse method in order to investigate the oxygen and hydrogen evolution reactions. Experiments were performed at 600° C on bright platinum electrodes with suitable oxygen or hydrogen electrodes as reference electrode. Results account for the high values of solubility of water and hydrofluoric acid in molten alkali fluorides

and give some insight into the kinetics of the oxygen and hydrogen electrode reactions. Author

N65-30675# Los Alamos Scientific Lab., N. Mex.
THE X-RAY FLUORESCENCE SPECTROMETRIC DETERMINATION OF PLUTONIUM IN URANIUM-PLUTONIUM-MANGANESE ALLOYS
E. A. Hakkila, R. G. Hurley, and G. R. Waterbury 28 Jul. 1965 17 p
(Contract W-7405-ENG-36)
(LA-3333) CFSTI: $1.00

Plutonium in uranium-plutonium-manganese alloys is determined without chemical separation using an x-ray fluorescence spectrographic method. The ternary alloy is dissolved in hydrochloric acid, thorium is added to serve as the internal standard, and the solution is irradiated using a tungsten target x-ray tube. The ratios of the intensities of the $L\alpha_1$ x-ray lines for thorium and plutonium are measured. The method is applicable to the determination of 10 to 50% of plutonium with a relative standard deviation of approximately 1.3% for samples containing no greater than 50% of uranium. Greater uranium concentrations result in selective enhancement of the thorium internal standard line, requiring separate calibration curves for samples containing greater than 50% of uranium. Sulfuric acid is added to samples and standards to minimize absorption effects. Author

N65-30707# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
THE EFFECT OF CHEMICAL COMBINATION ON THE X-RAY K EMISSION SPECTRA OF OXYGEN AND FLUORINE Technical Report, Jun.–Nov. 1964
David W. Fischer Apr. 1965 20 p refs
(AFML-TR-65-58; AD-616766)

Band shapes, wavelengths, and intensities are presented and discussed for the K emission spectra of oxygen and fluorine from some simple oxides and fluorides. It is shown that band shapes and peak positions are dependent upon the target material from which they are emitted. Evidence is presented illustrating that this dependence is in part due to such solid state properties as crystal structure, valence, and coordination. Results were obtained from a flat crystal vacuum spectrometer with a thin window flow proportional counter using electron excitation. Author

N65-30753# Midwest Research Inst., Kansas City, Mo.
STRUCTURAL STUDIES OF INORGANIC OXIDIZERS Quarterly Report, 1 Jan.–31 Mar. 1965
4 May 1965 32 p refs
(Contract AF 04(611)-10215; ARPA Order 24)
(QR-3; AD-614805)

It was established that OF_2 dissociates photolytically into a paramagnetic species in which there is a hyperfine interaction between the unpaired electron and one fluorine nucleus. The radical was characterized by means of the EPR spectrum, but not identified. However, the characteristics of the spectrum indicate that the radical is O_xF rather than F. It is highly probable that the same O_xF radical exists in the higher oxygen fluorides and indeed, may be the basic structural unit for synthesizing O_xF_y and related compounds. The interaction of the photolytic OF_2 species in NF_3 (liquid) solvent results in a destruction of the paramagnetic entity rather than a stabilization. This is further evidence that photolysis of OF_2 produces a radical rather than an ion species. TAB

N65-30806# United States Rubber Co., Wayne, N. J.
PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Quarterly Report, 1 Feb.–30 Apr. 1965
Douglas I. Relyea, Gerald J. Klender, and Aspet Merijanian 14 May 1965 20 p refs
(Contract NObs-92060)
(QR-2; AD-616761)

A soluble P-O-P linked polymer of MW(n) 7000 was obtained and found to be stable to 317C. The P-O-P linked polymer in which the theoretical repeating unit is -P3N3(OC6H5)4)- appears slightly more stable than the polymer with the theoretical repeating unit -P3N3(C6H5)2-(OC6H5)2O-. Polar solvents accelerate the reaction of P3N3C16 and hydroquinone at 80. A soluble polymer of MW(n)>6000 was prepared from P3N3(OC6H5)4C12 and disodiobisphenol A. Preliminary experiments directed toeard preparing carborane-linked phosphonitrilic polymers are described. Author

N65-30813# Battelle Memorial Inst., Columbus, Ohio.
THE THERMAL STABILITY OF SOME ARYLSILANES Interim Report, 1 May 1960–30 Apr. 1964
Arthur Levy, Robert W. Coutant, Earl L. Merryman, and Donald E. Trent Wright-Patterson AFB, Ohio. ARL, Apr. 1965 47 p refs
(Contract AF 33(616)-7236)
(ARL-65-64; AD-615558)

The decomposition of the following arylsilanes has been investigated by static and flow procedures: (I) tetraphenylsilane, (II) triphenylsilane, (III) diphenylsilane, (IV) monophenylsilane, (V) hexaphenyldisilane, (VI) triphenyl-bromophenylsilane, (VIII) diphenyl-bis(bromophenyl)silane. I and V decompose via first-order processes, and yield as major products benzene, triphenylsilane, and o-biphenylyl triphenylsilane (and tetraphenylsilane in the case of V). II, III, and IV decompose via second-order processes, disproportionating to corresponding higher and lower phenyl silanes, e. g., II $\rightarrow$ I + III, III $\rightarrow$ II + IV, and IV $\rightarrow$ III + SiH_4. VI and VIII decompose about 100° C below I and yield tetraphenylsilane and what appears to be triphenyl-bromosilane. The following rate data were obtained for the more thoroughly studied silane pyrolyses:

I	$\ln k(min^{-1}) = 34.40 - 67,000/RT$
	T = 561–588° C
II	$\ln k(1/mole-min) = 49.76 - 70,100/RT$
	T = 459–505° C
III	$\ln k(1/mole-min) = 44.99 - 55,800/RT$
	T = 383–419° C
V	$\ln k(min^{-1}) = 25.60 - 44,700/RT$
	T = 465–511° C

The high-frequency factors obtained for II and III, and the low-frequency factors obtained for I and V do not permit one to generalize on a single decomposition mechanism, applicable to all the arylsilanes at this time. Author

N65-30838*# Dynamic Science Corp., Monrovia, Calif.
A BASIC STUDY OF THE NITROGEN TETROXIDE–HYDRAZINE REACTION
Harold G. Weiss Jul. 1965 56 p refs Prepared for JPL
(Contracts NAS7-100; JPL-BE4-229751)
(NASA-CR-64338; SN-4500) CFSTI: HC $3.00/MF $0.50 CSCL 21I

Data from the study of the hydrazine–nitrogen tetroxide reaction show that hydrazine–nitrogen tetroxide impinging jets are diverted by interaction between the two propellants. The principal factors which cause this phenomenon are: (1) immiscibility of the two reactants; (2) rapid reaction rate between N_2O_4 and N_2H_4; and (3) the high heat evolution and large gas

volume generated by reaction. These factors are discussed in detail in addition to the whole experimental program. N.E.A.

N65-30873# Colorado Univ., Boulder. Dept. of Chemistry.
HALOGENOID COMPLEX Progress Report, 30 Sep. 1964–1 Apr. 1965
R. N. Keller. 12 May 1965. 4 p. ref.
(Grant DA-ARO(D)-31-124-G198)
(PR-7; AD-617165)

Work continued on cyanate chemistry, the dissociation constants of pseudohalic acids, and the reduction rate of $Co(NH_3)_5X^{2+}$ compounds by introduction of Cr^{2+}. First, the exact dissociation constants for HCN, HOCN, HSCN, HN_3, and HSeCN were determined at 20°, 26°, and 33°, and the values for $\Delta F°$, $\Delta H°$, and $\Delta S°$ were calculated. Secondly, approximate relative rates of 1:3:11 were found for the chlorine, bromine, and iodine complexes, respectively, by Cr^{2+} reduction of the $Co(NH_3)_5X^{2+}$ ions (with X = Cl, Br, and I). G.G.

N65-30876# Lexington Labs., Inc., Cambridge, Mass.
EVALUATION OF VAPOR DEPOSITION GROWTH OF OXIDE SINGLE CRYSTALS FROM METAL HALIDES Final Report, 1 May 1964–30 Apr. 1965
Philip S. Schaffer. May 1965. 45 p. refs.
(Contract Nonr-4574(00); ARPA Order 306)
(AD-616914)

A vapor phase growth technique was developed for the epitaxial growth of oriented ruby monocrystals. Crystals were grown up to 90.7 grams in 52 hours. Detailed investigations were made to determine the variables which influenced the formation kinetics of the reaction. Crystals were grown with total impurity levels as low as 4 ppm. Dislocation density decreased with increasing thickness of vapor overgrowth. Densities as low as $13/cm^2$ were measured on large vapor-grown α-Al_2O_3 platelets, although the vapor-grown monocrystals generally exhibited a density reduction of one to three orders of magnitude over their flame fusion substrates. Author

N65-30877# Catholic Univ. of America, Washington, D. C. Dept. of Chemistry.
REACTIONS OF CALCIUM, MAGNESIUM AND CERIUM HYDRIDES WITH AQUEOUS SOLUTIONS
Raymond A. Sutula and John B. Hunt. 15 May 1965. 10 p. refs.
(Contract Nonr-2249(11))
(TR-1; AD-616633)

The hydrolysis of CaH_2 by D_2O is rapid and quantitative, and the hydrogen of the hydride is transferred quantitatively to the gas phase without exchange with the solvent. The principal gaseous product is HD, although the proportion of HD is smaller than for the alkali metal hydrides. The isotopic course of the reaction is not very sensitive to acidity of the medium or to the presence of metal ion oxidizing agents, and only hydrolysis is observed in the presence of a wide variety of oxidizing agents. The hydrolysis of MgH_2 is much slower, and the proportion of HD formed in the reaction with D_2O is slightly smaller than for CaH_2. Hydrolysis occurs without isotopic exchange, and the proportion of HD increases slightly with the acidity of the medium. Oxidation of MgH_2 by Ag^+ competes effectively with hydrolysis, the hydride ion being oxidized quanitatively to hydrogen gas with considerable isotopic exchange with the solvent. Hydrolysis of CeH_2 in D_2O is slower than that of CeH_3 and is accompanied by considerable loss of D to the solvent by exchange. Author

N65-30893# Tulane Univ., New Orleans, La.
PHYSICAL AND PREPARATIVE STUDIES OF TRANSITION METAL CHELATES
R. D. Archer. Wright-Patterson AFB, Ohio, ARL, Apr. 1965. 32 p. refs.
(Contract AF 33(615)-1043)
(ARL-65-70; AD-617067)

The "partial paramagnetism" of several nickel (II) unsaturated β-ketoamine complexes has been found to be due to decomposition and water effects. Several other ketoamine complexes have been prepared, but none has been found suitable for vapor phase chromatography. A new 8-hydroxyquinolato complex of molbdenum has been isolated and the isomers of trichlorotripyridinemolybdenum (III) have been studied. Investigations of tungsten (III) and -(IV) complexes are in progress. Calculations of absorption band spectra for several trifuloromethyltetrazolyl complexes have been made and structures determined. Author

N65-30896# California Univ., Berkeley. Lawrence Radiation Lab.
INORGANIC MATERIALS RESEARCH DIVISION ANNUAL REPORT, 1964
Leo Brewer et al. Feb. 1965. 152 p. refs.
(Contract W-7405-ENG-48)
(UCRL-11889) CFSTI: $5.00

Progress is reported on inorganic materials research under the subjects of *Chemistry; Metallurgy;* and *Physical Ceramics. Inorganic Chemistry; Chemical Thermodynamics; Solid-State Chemistry and Physics; Electrochemistry;* and *Physical Chemistry* are included under the general heading of *Chemistry. Crystal Imperfections; Kinetics of Dislocation Mechanisms; Relation of Structure to Properties in Metallic Systems; High Strength Materials; High Field Superconductivity;* and *Thermodynamics of Metal Systems* are discussed for the division of *Metallurgy.* The work on *Physical Ceramics* pertains to *High Temperature Reactions; Development and Behavior of Microstructures in Ceramic Systems;* and *Relation of Structure to Properties in Ceramic Systems.* E.E.B.

N65-30906# California Univ., Berkeley. Dept. of Chemical Engineering.
MIXING AND CHEMICAL REACTION IN TURBULENT FLOW REACTORS
R. Norris Keeler, E. E. Peterson, and John M. Prausnitz. [1965] 18 p. refs.
(Contract W-7405-ENG-48)
UCRL-7759-T)

Mixing and a rapid, second-order irreversible chemical reaction were studied in a turbulent chemical flow reactor, using a point conductivity probe to detect changes in concentration. Using the mathematical theory of Toor, it is shown experimentally that data on the mixing of a passive scalar additive in a non-reactive system may be used accurately to predict the yield of a rapid, irreversible second-order reaction when the hydrodynamics and initial conditions on mixing for the reactive system are identical to those of the non-reactive system. Increasing the bulk average concentration of one reactant is shown to have a strong effect on the overall reaction yield. Author

N65-30913# Franklin Inst., Philadelphia, Pa. Franklin Inst. Research Labs.
A STUDY OF SURFACE PHENOMENA ON ORGANIC SOLIDS Quarterly Progress Report No. 3, 10 Dec. 1964–9 Mar. 1965
P. J. Reucroft, P. Chairge, and M. M. Labes. 19 Mar. 1965. 13 p. refs.
(Contract DA-18-035-AMC-141(A))
(Q-B2227-3; AD-615126)

The adsorption of krypton and ammonia on the organic solid p-chloranil has been investigated. Isotherms were obtained for krypton at 77.36° K and ammonia at 194° K. The adsorption of krypton is reversible and reproducible. The affinity for ammonia is much higher, irreversible behavior and reduced adsorptive capacity on repeated adsorption being obtained for this system. These results indicate that the adsorption of krypton is pure physical adsorption whereas ammonia is both physically adsorbed and chemisorbed. Author

N65-30919# Rensselaer Polytechnic Inst., Troy, N. Y. Corrosion Research Lab.
PRINCIPLES OF METALLOGRAPHIC ETCHING
Norbert D. Greene, Peter S. Rudaw, and Linda Lee (Watervliet Arsenal, N. Y.) Jun. 1965 26 p refs
(Contract Nonr-591(17))
(TR-2; AD-616786)

The principles of metallographic etching have been determined by electrochemical and optical measurements on tin-zinc alloys in sodium hydroxide electrolytes. The minimum dissolution rate ratio and the minimum amount of selective dissolution necessary to achieve metallographic contrast of phases have been measured. Etching rate and contrast are uniquely defined by etching potential by potentiostatic, electrolytic and chemical etching methods. Author

N65-30926# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE INTENSITY OF MUTUALLY-INDUCED X-RAY FLUORESCENCE BETWEEN ELEMENTS
Chi Chen, Hua-Lin Li, and Chia-Yen Ting 9 Jul. 1965 17 p refs Transl. into ENGLISH from Wu Li Hsueh'pao (Peking), v. 19, no. 11, 1963 p 727–734
(FTD-TT-64-1350/1+2+3+4; AD-466526)

In the present investigation a formula was derived for the intensity of mutually-induced X-ray fluorescence between elements. The formula was verified with the experimental data on the binary alloys of Ni and Fe. Author

N65-30946# Rensselaer Polytechnic Inst., Troy, N. Y. Corrosion Research Lab.
ELECTRODE MOUNTING FOR POTENTIOSTATIC ANODIC POLARIZATION STUDIES
N. D. Greene, W. D. France, Jr., and B. E. Wilde May 1965 8 p refs
(Contract Nonr-591(17))
(TR-1; AD-616630)

Samples of an arc melted, 10Cr–10Ni–Fe alloy were mounted with the Stern-Makrides compression gasket assembly. Some electrodes were mounted directly, others were partially encased or coated with various resins prior to mounting. Potentiostatic anodic polarization measurements were performed in hydrogen-saturated, normal sulfuric acid at 25C, using an identical potential step technique for each specimen. Polarization behavior in the active region is unaffected by mounting material. However, all resins except heat-cured epoxy and alkyd types, markedly increase apparent passive current density. This is due to the presence of fine crevices at the electrode-resin interfaces. Although the area within crevices may be small, current density is high, and the effect on measured passive currents is pronounced. The results indicate that crevices in, or adjacent to, electrodes must be avoided during potentiostatic anodic polarization measurements. Specimens should be mounted with the Stern-Makrides compression gasket, in heat-cured epoxy resin, in alkyd varnish or other methods which ensure freedom from microscopic crevices. Author

N65-30965# Monsanto Research Corp., Everett, Mass. Boston Lab.
CHEMILUMINESCENT SYSTEMS Technical Report No. 4
25 Jun. 1965 50 p refs
(Contract Nonr-4511(00); ARPA Order 299)
(MRB3009Q4; AD-617104)

Another functional class of organic materials, electronegatively substituted vinyl compounds, have been observed to yield relatively bright chemiluminescence in autoxidation reactions in basic, aprotic polar solvents. 4-Dimethyl amino benzoin has been found to produce a peak emission intensity significantly greater than that of benzoin. The relative emission intensities of indoles are orders of magnitude greater in aprotic solvents than in aqueous solution. For 2,3-dimethylindole this ratio is $> 10^6$. Luminescence spectra have been obtained for benzoin, 2,3-dimethylindole and indole-5-carboxylic acid as a function of degree of reaction and base concentration. The observed chemiluminescence spectrum for benzoin oxidation corresponds to the fluorescence spectrum of benzil although benzil fluorescence has not been observed in the luminescence spectrum of oxidized benzoin solutions. The chemiluminescence spectrum of 2,3-dimethylindole corresponds to the fluorescence spectrum of a stable reaction product. The chemiluminescence spectrum of indole-5-carboxylic acid is similar to that of 2,3-dimethylindole but does not correspond with the fluorescence spectrum of any observed (stable) product. Author

N65-30986# National Research Council of Canada, Ottawa (Ontario).
THE VAPOUR PRESSURE OF SULPHUR OVER IRON–SULPHER MELTS [DAVLENIE PARA SERY NAD RASPLAVAMI ZHELEZO–SERA]
V. T. Burtsev, R. A. Karasev, and A. M. Samarin 1963 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Met. I Toplivo (Moscow), no. 2, 1962 p 42–48
(NRC-TT-1104)

Many reports have been devoted to the study of the thermodynamic properties of Fe-S melts. From these and other investigations it was shown that the solution of sulphur in liquid iron, up to 0.5% S, complies with Henry's law. A substantial part of the above-mentioned investigations was carried out by the method of studying the equilibrium constant of a melt with a gas mixture consisting of hydrogen sulphide and hydrogen. On the basis of these investigations the value of the vapour pressure of sulphur dissolved in liquid iron has been estimated with the use of appropriate calculations. However, the data obtained in this way does not correspond with the rate of sulphur elimination when the liquid metal is kept in a vacuum. For this reason it was felt necessary to determine experimentally the composition of the vapour phase over molten Fe-S and the absolute vapour pressure of the components containing sulphur. Author

N65-30992 Joint Publications Research Service, Washington, D. C.
ELECTROCHEMISTRY OF FUSED SALTS AND ITS APPLICATIONS
Jui-wu P'eng *In its* Transl. on Communist China's Sci. and Technol., No. 202 9 Aug. 1965 p 12–31 refs Transl. into ENGLISH from K'O Hsueh T'ung Pao (Peking), no. 5, May 1965 p 415–424 (See N65-30991 19-34) CFSTI: $4.00

An overall view of fused salt electrochemistry and its applications is given. Discussed are: (1) electrical conductance and transport number; (2) fused salt primary cells; (3) electroanalysis of fused salts; (4) polarization processes; (5) purification of fused salts; (6) reference electrodes; (7) experimental materials; (8) structures of fused salts and complex ions; (9)

thermodynamic properties of molten salts; (10) dissolving and corrosion of metals in fused salts; (11) electrolysis of fused salts and its mechanism; and (12) the determination of microquantities of impurities in fused systems. G.G.

N65-30995 Joint Publications Research Service, Washington, D. C.

THE SECOND VIRIAL COEFFICIENTS OF ORGANIC VAPORS

Yuan-ch'i Chang, Hung-tao Wang, and Huang Te *In its* Transl. on Communist China's Sci. and Technol., No. 202 9 Aug. 1965 p 58–67 refs Transl. into ENGLISH from K'o Hsuh T'ung Pao (Peking), no. 5, May 1965 p 437–440 (See N65-30991 19-34) CFSTI: $4.00

Experimentally determined second virial coefficients for dimethyl, methylethyl, and diethyl ketones were used to verify molecular models for mixtures of benzene and ketones that were based on the interactions among nonpolar, as well as polar molecules. Also obtained were the molecular mechanical parameters of these compounds. The computed results agreed basically with the experimental data. G.G.

N65-30997 Joint Publications Research Service, Washington, D. C.

POLYMORPHISM OF SILICON CARBIDE—38 NEW POLYMORPHS OF SiC

Ch'ang-lin Kuo *In its* Transl. on Communist China's Sci. and Technol., No. 202 9 Aug. 1965 p 85–92 refs Transl. into ENGLISH from K'O Hsueh T'ung Pao (Peking), no. 5, May 1965 p 451–454 (See N65-30991 19-34) CFSTI: $4.00

Fast speed photos of 600 silicon carbide polymorphs were analyzed by the point-to-point relationship method, and 26 new forms of trigonal multilayer type, and 12 new forms of hexagonal multilayer type polymorphs of silicon carbide were discovered. The crystalline characteristics and crystallographic data of these new forms are shown in a table. Experimental data on some 1100 crystallines established the following facts: (1) Hexagonal type polymorphs often coalesced with the trigonal type having three times as many layers as the former type. (2) Polymorphs often coalesced with other forms having a layer number exactly the multiples of the former. (3) Polymorphs of similar crystalline structures coalesced. (4) Polymorphs of the structural series (33...32), (33...34), and (22...23) have the highest occurrence. (5) Equal layer polymorphs occurring in different crystallines may have different crystalline structures. (6) Over 95% of silicon carbide crystals have one-dimensional disorders. G.G.

N65-30999# Joint Publications Research Service, Washington, D. C.

HEAT OF CRYSTALLIZATION OF SYNTHETIC MICA AND LITHIUM METASILICATE

Ch'ung-fan Ho, P'ei-tsun Li, and Chan Yueh *In its* Transl. on Communist China's Sci. and Technol., No. 202 9 Aug. 1965 p 99–103 refs Transl. into ENGLISH from K'O Hsueh T'ung Pao (Peking), no. 5, May 1965 p 457–458 (See N65-30991 19-34) CFSTI: $4.00

Measured heat crystallization data from two types of synthetic mica and from lithium metasilicate samples were obtained by plotting the values for the heat of crystallization against the area of the thermal peak for unit mass. The observed linearity indicated good agreement with the rule governing the relationship between crystallization heat and peak area of references. The obtained heat crystallization values for phlogopite ($KMg_3AlSi_3O_{10}F_2$), taeniolite ($KMg_2LiSi_4O_{10}F_2$), and lithium metasilicate were almost twice as great as formerly obtained values found through application of the Plato thermal analysis. G.G.

N65-31017# Los Alamos Scientific Lab., N. Mex.

A STUDY OF THE ONE-DIMENSIONAL, TIME-DEPENDENT REACTION ZONE OF NITROMETHANE AND LIQUID TNT

Charles L. Mader 4 Aug. 1965 54 p refs

(Contract W-7405-ENG-36)

(LA-3297) CFSTI: $3.00

The time-dependent reaction zones of nitromethane and liquid TNT have been investigated using one-dimensional numerical hydrodynamics with Arrhenius chemical reaction and accurate equations of state. The formation of an overdriven stable detonation in nitromethane by various types of pistons has been investigated. A piston whose velocity decreases abruptly to a lower value produces an initially short reaction zone which lengthens and decreases in pressure, when the second and lower velocity occurs, until the rate of release of chemical energy exceeds that necessary to sustain the wave. If the stepped-velocity piston has a sufficiently small lower step, failure of the detonation occurs in the time and space scale of interest. If the detonation is not sufficiently overdriven, the solution of the equations is nonsteady and periodic, oscillating about the steady-state (time-dependent) soluton. Author

N65-31054*# Unified Science Associates, Inc., Pasadena, Calif.

GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS Third Quarterly Report, 21 Feb.–20 May 1965

S. Naiditch [1965] 46 p refs

(Contract NAS7-326)

(NASA-CR-64347) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The objective of this program is to investigate the electrochemistry of dense gaseous solutions. Ammonia has been chosen as the solvent because of its low critical temperature and pressure and because it can be studied in glass cells since, unlike water, it does not dissolve glass under supercritical conditions. Author

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N65-31071# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

THE ELECTROLYTIC PREPARATION OF LEAD TARGETS FROM STABLE ISOTOPES ^{206}Pb AND ^{207}Pb IN SULPHATES FORM [ELEKTROLITYCZNE OTRZYMYWANIE TARCZ OLOWIOWYCH Z ROZDZIELONYCH IZOTOPOW ^{206}Pb I ^{207}Pb W POSTACI SIARCZANOW]

J. Mikulski and Z. Szeglowski Apr. 1965 6 p refs Submitted for Publication

(Rept.-406/C)

A simple method of preparing lead targets from lead sulphate containing stable ^{206}Pb or ^{207}Pb isotopes has been described. Lead was deposited by electrolysis first from lead sulphate in NaOH solutions and then from solutions in lead perchlorate. Author

N65-31085# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.

CARBORANE–SILOXANE ELASTOMERS, 19 FEBRUARY–18 MAY 1965

Joseph Green [1965] 16 p refs

(Contract DA-11-070-AMC-852(W))

(RMD-5065-Q1; AD-616649)

The synthesis of thermally stable carborane–siloxane elastomers was undertaken. Carborane and silane intermediates prepared include: neocarborane, 1,7-diallylcarborane, 1,7-bis[3-(chlorodimethylsilyl)propyl]carborane, tetramethyldisiloxane, dichlorotetramethyldisiloxane and chlorodimethylsilane. A liquid polymer was obtained by silyl hydride addition polymerization of 1,7-diallylcarborane and tetramethyldisiloxane. A homopolymer of 1,7-bis[3-(chlorodimethylsilyl)propyl]

carborane prepared by hydrolysis, was obtained as a gum; copolymers of this compound with diethoxydimethylsilane and dichlorotetramethyldisiloxane, obtained by alkoxy–halogen condensation and hydrolysis respectively, were liquids of 1800 and 2500 molecular weight. Author

N65-31098# Atomics International, Canoga Park, Calif.
A ROTARY KILN FOR THE CONTROLLED OXIDATION OF UC
S. Strausberg 30 Jun. 1965 26 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10485) CFSTI: $2.00

A rotary kiln was evaluated for the controlled oxidation of UC. The rotating kiln was 16 in. in diameter by 21 in. long and made of stainless steel. It was rotated at 8 to 10 rpm. The oxidation was followed by measurement of temperature of the charge and CO_2 concentration in the off-gas. The kiln performed satisfactorily. Several 10-kg batches were oxidized at a rate of 2 to 2-1/2 kg/hr at 400 to 500° C. Over 95% of the product was −200 mesh U_3O_8 when the starting material was reactive UC. This material is considered suitable feed material for reconversion to UC. Author

N65-31149# Mound Lab., Miamisburg, Ohio.
PENTAERYTHRITOL TETRANITRATE Bibliography
M. R. Kantz 30 Jul. 1965 22 p
(Contract AT(33-1)-GEN-53)
(MLM-1252) Available from AEC, Oak Ridge, Tenn.: $0.50

N65-31154# United Nuclear Corp., White Plains, N. Y. Development Div.
STUDY OF URANIUM–PLUTONIUM MONOXIDES Progress Report, Feb. 1–Jul. 31, 1964
D. Stahl, A. Strasser, J. Andersen, and K. Taylor (Carborundum Co.) 5 Oct. 1964 26 p refs
(Contract AT(30-1)-3305)
(UNC-5096)

Large amounts of Pu(OC) phase mixed with Pu_2O_3 were synthesized by carbon reduction of PuO_2. Single phase PuO_3 was formed by the same process by adjusting the C content in the reaction mix. Pellets of these materials were produced by cold pressing and sintering. A mixture of about 50% of (UPu)(OC) phase with an oxygen depleted XO_2 phase was produced by the carbon reduction of a 50% UO_2 +50% PuO_2 mixture. Only small amounts of (UPu)O were found mixed with two XO_2 type phases after UH_3 reduction of PuO_2. Carbon seems to be necessary for monoxide stabilization. Pellets of the monoxide and dioxide mixture were produced by cold pressing and sintering. The gravimetric technique for oxygen-to-metal ratio by oxidation and reduction was set up and tested with a National Bureau of Standards U_3O_8 standard. The autoclave and associated equipment for water corrosion testing of pellets was designed. R.N.A.

N65-31157# Pittsburgh Univ., Pa.
1: A STUDY OF RARE GAS DIFFUSION THROUGH SOLIDS. II: ANALYSIS OF GEOLOGIC AND COSMOLOGIC SAMPLES Final Report
Joseph I. Lipson 30 Sep. 1964 9 p refs
(Contract AT(30-1)-2951)
(TID-21249)

The diffusion of rare gases through solids was investigated with a view to interpreting the mechanism for diffusion in light of the fact that there was no theoretical basis for the diffusion rates of rare gases in any solids. Also, the possibility of the diffusion of rare gases in metals was examined. It was verified that helium does permeate Kovar. In the ionic conductivity experiments, a reproducible anisotropy of conductivities and activation energies was observed. The anisotropy was related to basic crystal axis orientation and related to twin planes in the crystals. The results support the idea that ionic conductivity and rare gas diffusion are controlled by the specific atomic arrangement within the crystal and that generalizations on the basis of perfect crystals have no relation to the facts of rare gas materials in actual materials. E.E.B.

N65-31162# India. Dept. of Atomic Energy, Bombay.
SPECTROGRAPHIC ANALYSIS OF TITANIUM-DIOXIDE
T. S. Krishnan, Prem Kumar Dhall, and A. S. Rao 1964 16 p refs
(AEET(MET)5)

A spectrographic method has been described for the estimation of the following impurities in titanium dioxide: Ni, Co, Sn, 0.001–0.1%; Pb 0.0025–0.1%; Sb 0.005–0.1%; Cu 0.0075–0.1%; Nb 0.05–0.5%; Mn, Cr, Mg 0.001–5%; Fe, Al 0.005–5%; V 0.005–0.5% and Si 0.25–5%. The method involves mixing the sample in the ratio 1:2 with a buffer containing equal portions of graphite and zinc oxide and then exciting in a D.C. arc using a shallow cup electrode. Using titanium as the internal standard, the standard deviations for most of the elements lie within 10% of the estimated averages of the above concentrations. The method is applicable to the analysis of titanium and its alloys after conversion of the metals to the oxide form. Author

N65-31165# New York Univ., N. Y. Research Div.
COMBINED EFFECTS OF ULTRA-HIGH PRESSURE AND RADIATION ON ORGANIC MONOMERS AND POLYMERS Final Report, 1 Mar. 1963–31 Oct. 1964
Martin Price Washington, AEC, May 1965 90 p refs
(Contract AT(30-1)-3185)
(NYO-3185-1) CFSTI: $3.00

Studies were made on the post-irradiative high pressure polymerization of acrylamide, using gamma and electron beam irradiation. Radicals formed by radiation of monomeric acrylamide were frozen at −198° F and subsequently polymerized at pressures up to 500 000 psi and temperatures varying from ambient to 150° C. High pressure polymerization gave large increases in molecular weight over nonpressurized systems; in some cases a 100% increase was observed. Also, several sterically hindered ethylene derivatives were studied using the post-irradiation high pressurization technique. These included tetrachloroethylene, tetrabromoethylene, tetraiodoethylene, tetracyanoethylene, and tetraphenylethylene. Up to 20% of tetrabromoethylene was made to react. The product was a low molecular weight material which appeared to be a trimer. Tetracyanoethylene also reacted with an apparent conversion of about 20% of the monomer. None of the other materials could be induced to polymerize. The most important material synthesized was polyacrylamide. A series of new reactions of aliphatic and aromatic nitriles was also discovered. E.E.B.

N65-31181*# Bendix Corp., Ann Arbor, Mich. Systems Div.
STUDY OF MINERAL STABILITY IN THE LUNAR ENVIRONMENT First Quarterly Progress Report, 16 Nov. 1964–16 Feb. 1965
Feb. 1965 79 p ref
(Contract NAS9-3734; BSD Proj. 82911)
(NASA-CR-65094; BSR-1111) CFSTI: HC $3.00/MF $0.75
CSCL 07B

Fourteen minerals and glasses were investigated which included twelve natural and two synthesized materials: NH4-feldspar, hematite, antinolite, antigorite, talc, muscovite, natrolite, calcite, gypsum, goethite, basalt glass, tektite, plagioclase

(irradiated), and calcium-montmorillonite. The ammonium feldspar was prepared by synthesizing an anorthoclase with NH_4Cl at approximately 14 000 psi. The basalt glass was produced by fusing a pure basalt. Thermal, mass spectrometer, and chemical test data were summarized and graphically depicted. Also, fabrication of long-term test apparatus was studied. R.W.H.

N65-31190# Union Carbide Research Inst., Tarrytown, N. Y.
FLUORINE OXIDIZERS Quarterly Technical Report No. 8, 1 Mar.–1 Jun. 1965
R. H. Toeniskoetter and F. P. Gortsema [1965] 27 p refs
(Contract DA-31-124-ARO(D)-77; ARPA Order 402)
(ARO-D-4134-3; AD-465186)

Characterization of the product of the reaction of chloryl fluoride with alkali metal azides included the determination of the absorption spectrum and study of the reaction with boron trifluoride. Other routes to the NOF^- ion which were investigated included the reactions of tetrafluorohydrazine with metal chlorates, perchlorates and nitrates. The nitrates of potassium and silver underwent reactions above 60° with formation of nitrosyl fluoride in 37–75% yields. Reactive solids were produced in the chlorate and nitrate reactions; however, the principal solid products were the corresponding fluorides. The reactions of platinum hexafluoride with tetrafluorohydrazine, nitrosyl fluoride and nitric oxide have been investigated. The reaction with tetrafluorohydrazine gives nitrogen trifluoride and a solid which has not been characterized but for which X-ray data are reported. Nitrosyl fluoride and platinum hexafluoride give a yellow solid which has been tentatively formulated as $NO^+PtF_7^-$ on the basis of stoichiometric, infrared and X-ray data. The same substance is produced in the reaction between nitric oxide and platinum hexafluoride. Author

N65-31221# Union Carbide Nuclear Co., Oak Ridge, Tenn. Nuclear Div.
PREPARING AND SINTERING TUNGSTEN POWDER
C. R. Schmitt, L. R. Phillips, J. M. Googin, and C. F. Piper
20 Aug. 1965 98 p refs
(Contract W-7405-ENG-26)
(Y-1476) CFSTI: $3.00

Variables affecting the production of a sinterable, high-purity, tungsten metal powder by the hydrogen reduction of tungsten oxides have been studied; and ultra-fine tungsten powder, submicron in size, with high surface areas ranging from 5 to 15 square meters per gram, have been prepared. Sintering tests on isostatically pressed compacts made from these powders showed that a density that is 95–98% of the theoretical density can be obtained by sintering for three hours at 1500° C in a flowing hydrogen atmosphere. This level is much better than the approximately 80–85% of the theoretical density obtained from compacts made from a typical, fine, commercially available tungsten powder having a surface area of 0.2 square meter per gram sintered under equivalent conditions. Studies show that when tungsten oxides are reduced with hydrogen under increasing reduction temperatures in the range between 700–850° C, a decrease occurs in the surface area of the resulting tungsten powders. Sintering tests on pressed compacts made with these powders also showed that a high reduction temperature has an adverse effect on the sintered density. Author

N65-31226# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTARY PROCESSES OF HIGH-ENERGY CHEMISTRY
V. L. Tal'Roze and Ye. L. Frankevich 19 May 1965 10 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7 1963 p 113–114
(FTD-TT-65-75/1; AD-617147)

From the 18th to the 22nd of March in Moscow in the Institute of Chemical Physics of the Academy of Sciences of the USSR there was held a symposium on the elementary processes of high-energy chemistry. During the sessions there were discussed the following general problems: elementary processes in gases, elementary processes in liquids and solids (with the participation of excitations states of free radicals and ions), and elementary processes in quantum generators. TAB

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-30209 Library of Congress, Washington, D. C. Aerospace Technology Div.
A METHOD FOR DETERMINING RADIATION PATTERNS OF SLOT ANTENNAS
Arsen Iwanovsky *In its* Foreign Sci. Bull., Vol. 1, No. 7 Jul. 1965 p 6–10 refs (See N65-30207 19-34)

A method has been proposed for obtaining the distribution pattern of electrical current on a body of revolution excited by a slot. The method, which has the advantage of using integral equations instead of eigenfunctions, was applied to an analytical determination of the radiation pattern of a dipole of finite thickness. The determination of radiation patterns of transverse slot antennas on the face and side surfaces of a thick cylinder of finite length represents the final effort in a series of associated works. Author

N65-30258 Joint Publications Research Service, Washington, D. C.
CONCERNING SEQUENTIAL DECODING BY THE WOZENCRAFT-REIFFEN METHOD
R. L. Dobrushin *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 185–200 refs (See N65-30250 19-10)
CFSTI: $7.00

Sequential coding, with the assumption that the number of incorrect solutions tends to approach zero, is considered in a theoretical framework. Decoding is specified by arbitrary function; and random standard, and random standard tree codes are discussed. An algorithm for computation of all the bits of a message is subdivided into several stages, and a series of assumptions are made and proofs are offered. Decoding, which is executed in succession, is performed in the same manner at each stage. M.W.R.

N65-30259 Joint Publications Research Service, Washington, D. C.
DECODING AUTOMATA WITH INTITIAL-STATE INVARIANCE
V. I. Levenshteyn *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 201–217 refs Presented at the All-Union Conf. on Theory of Coding and its Application, Odessa, May–Jun. 1963 (See N65-30250 19-10) CFSTI: $7.00

This article is concerned with decoding automata which decode messages correctly regardless of the state in which they were at the initial time instant. The decoding automata with this property *eliminate* the effect of malfunctions (random

transitions of an automaton, from one state to another or errors in the input sequence), since a malfunction during the decoding of a single symbol of a message will not in this case affect the correctness of the decoding of the subsequent symbols of the message. In the case of self-adaptive decoding automata a malfunction, generally speaking, reduces to the incorrect decoding of a number of successive symbols of a message, since self-adaptive automata merely *restrict* the effect of malfunctions to a certain time interval. The principal finding of this study consists in determining the property of coding that is necessary and sufficient for the existence of a decoding automaton which correctly decodes messages regardless of its initial state, and also in obtaining certain estimates for the codings having this property. Author

N65-30260 Joint Publications Research Service, Washington, D. C.
NONUNIFORM CODES WITH ERROR CORRECTION
A. A. Markov *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 218–245 refs (See N65-30250 19-10) CFSTI: $7.00

Transmission may involve additive or timing errors in the transmitter-receiver link so that the decoder input receives incorrect words. Encoding systems that permit correction of additive errors in cases where timing errors are presumed to be nonexistent are discussed. The requirement restricting the class of acceptable codes is associated with the class of admissible error positions; the latter determined by the extent to which a message-transmission system is reliable and the precise nature of the possible errors. The concept of class of error distributions in message codes is introduced. A formula for determining the order of independence of the word system is given, and the advantages of using the certain encoding word systems are proved with a theorem. Words that display the prefix property are treated, and illustrative examples are included. M.W.R

N65-30344# Rome Univ. (Italy). Inst. of Electronics.
MODES IN WAVEGUIDES FILLED WITH LONGITUDINALLY MAGNETIZED FERRITE Interim Scientific Report No. 1
Giorgio Gerosa 28 Apr. 1965 4 p refs
(Contract AF 61(052)-807)
(AFCRL-65-390; AD-617742)

A model solution for a cylindrical waveguide of arbitrary cross section filled with longitudinally magnetized ferrite given by Ll. G. Chambers is criticized. Author

N65-30454*# Quan-Tech Labs., Inc., Whippany, N. J.
STUDY OF THE RELATIONSHIP OF NOISE AND COMPONENT RELIABILITY Fifth Monthly Report, 1 Jun.–1 Jul. 1965
[1965] 15 p
(Contract NAS5-9550)
(NASA-CR-64188) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Progress is reported on a study program designed to determine which type or types of noise measurements is the most effective screening tool for detecting defective transistors and to establish a cull line or screening level for this measurement. Data obtained from the study will be used to determine the relationship between noise and component reliability, and where possible to determine the nature of the defects in abnormal transistors. A detailed description of the work performed during this report period is given. N.E.A.

N65-30455*# General Precision, Inc., Glendale, Calif. Librascope Group.
IMAGE ANALYSIS OF AREA-SCAN TELEVISION
7 Mar. 1964 99 p Prepared for JPL
(Contracts NAS7-100; JPL-950686)
(NASA-CR-64199) CFSTI: HC $3.00/MF $0.75 CSCL 17B

An area scan television method is described for reproducing a two-dimensional image at a remote location. The method uses a scanning aperture pattern at both the transmitter and receiver which consists of many individual randomly placed apertures which are illuminated simultaneously. Criteria for judging the quality of a replica, the practical realizability of the mechanically scanning aperture patterns used in area scan television, and the system performance of this type of television are described. Four general forms of aperture patterns that provide perfect replicas by satisfying less restrictive sufficient conditions for perfect replication are derived. The relative merits of area scan television and spot scan television are discussed. Spot scan instrumentation is simple and reliable, and requires no high voltage supply and no sweep circuits. However, area scan signals are secure in that they can not be reproduced unless the form of scanning aperture pattern is known. Area scan television can be used to improve the quality of the received image by reducing the effect of the noise generated in the low level circuits of the transmitter. R.N.A.

N65-30462*# Alabama Univ., University. Bureau of Engineering Research.
MUTUAL IMPEDANCE EFFECTS IN SCANNED ANTENNA ARRAYS Technical Report No. 2
Harold Mott and David N. Mc Quiddy 1 Jul. 1965 54 p refs
(Contract NAS8-11295)
(NASA-CR-64190) CFSTI: HC $3.00/MF $0.50 CSCL 09F

The results of a study of the current literature dealing with mutual impedance effects in electronically-scanned antenna arrays are presented. Various methods of minimizing the harmful effects of impedance variation with scan angle are analyzed. Factors contributing to the optimum design of arrays are presented. Author

N65-30466*# Westinghouse Corp., Baltimore, Md. Surface Div.
SPECIFICATION, RF TEST CONSOLE, APPENDIX A Part of the Final Report
G. R. Vaughan 1 Feb. 1965 50 p Prepared for JPL
(Contracts NAS7-100; JPL-950144)
(NASA-CR-64193) CFSTI: HC $3.00/MF $0.50 CSCL 17B

This report covers the requirements for the design and fabrication of special RF test equipment to be used as a precision transmitter-receiver combination designated an "RF Test Console." N.E.A.

N65-30475*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
ON THE CORRELATION RADIOMETER TECHNIQUE
K. Fujimoto 11 Jan. 1962 53 p refs *Its* Rept.-1093-1
(Grant NsG-74-60)
(NASA-CR-64123) CFSTI: HC $3.00/MF $0.50 CSCL 20F

In studying the possible usefulness of the correlation radiometer, comparison was made with the Dicke-type radiometer, and special emphasis was placed on millimeter applications. The correlation radiometer consists of two receiver systems with separate antennas, which look at the same signal source and are thus correlated in time. An analysis was made of the effects of gain fluctuation and such receiver characteristics

as unequal bandwidth and phase errors on the sensitivity of the radiometer. An experimental model of the correlator was tested to examine its practical capability. It is concluded that the correlation radiometer is limited to special applications but if, in the future, the limitation on bandwidths is no longer a problem it would be more attractive than the Dicke system, especially in the millimeter wave length. C.T.C.

N65-30511# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
DATA ANALYSIS OF ECHO I, II AND THE MOON. VOLUME III: THE SURFACE ROUGHNESS OF ECHO II, ECHO I, AND THE MOON AS OBTAINED FROM AMPLITUDE STATISTICS
J.W. Eberle Griffiss AFB, N. Y., RADC, May 1965 28 p refs
(Contract AF 30(602)-2166)
(RADC-TR-65-67, Vol. III; AD-617537)

The first amplitude probability density functions of signals reflected from Echo II, Echo I and the Moon are compared. From the density functions for Echo II, the ratio of specular power (correlated) to scattered power (uncorrelated) and the range of fading are obtained, from which the behavior of the surface characteristics are obtained as a function of time during the first four months in orbit. Author

N65-30523# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-Sous-Bagneux.
PROPAGATION OF ELECTROMAGNETIC WAVES IN THE IONIZED ENVIRONMENT AROUND A HYPERSONIC ENGINE [PROPAGATION D'ONDES ELECTROMAGNETIQUES DANS LE MILIEU IONISE ENTOURANT UN ENGIN HYPERSONIQUE]
Jacques Dorey [1965] 13 p refs in FRENCH Presented at the Meeting on Antennas in Ionized Environment, Paris, 21–25 Jun. 1965
(ONERA-TP-254(1965))

Characteristics of reentry plasmas around hypersonic engines are determined. Propagation of electromagnetic waves in the plasmas, and the conditions for uncoupling between the propagation of pure and charged electromagnetic waves, are studied. A condition for dielectric approximation is deduced which is treated by the Ginzburg equation. It is established that most of the flow is neutral and that the gradients of density or temperature usually take place over distances of a few centimeters. Transl. J.M.D.

N65-30526# Raytheon Co., Burlington, Mass. Spencer Lab.
THE CASE FOR THE MICROWAVE POWERED HELICOPTER AS A COMMUNICATIONS PLATFORM AT 5000–10,000 FOOT ALTITUDE
W.C. Brown 19 Nov. 1964 20 p
(AD-465816)

This paper points out and supports with evidence that microwave powered helicopters can be rapidly developed to an operational capability of between one and two miles making use, for the most part, of existing component technology and a conservative approach to microwave antenna design. N.E.A.

N65-30578# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
STUDY AND ANALYSIS OF SIGNAL DISPLAY AND BANDWIDTH COMPRESSION TECHNIQUES Final Report, 15 Jun. 1964–14 Jun. 1965
Berry O. Pyron and Frank R. Williamson, Jr. 14 Jun. 1965 208 p refs
(Contract DA-49-092-ARO(D)-52)
(AD-616644)

Experimentation was performed with two analog signals representing running-average measures of the rates of occurrence of zero-axis crossings, and of maxima and minima in the signal speech. Another analog signal utilized was a smoothed version of the amplitude envelope of the speech signal. It was found that these signals tended to undergo characteristic patterns of change for a given element of speech. A vector display technique was studied in which two of the derived analog parameter signals characterizing an input signal were applied to the x- and y-deflection plates of a storage-type oscilloscope. Results show that the vector display offered considerable promise as a technique for speech analysis, to supplement the sound spectrograph—currently the chief tool in studies on the basic nature of speech. R.W.H.

N65-30623*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SPACE VEHICLE SA-6 TELEMETRY SYSTEM
23 Jun. 1965 70 p ref
(NASA-TM-X-53284) CFSTI: HC $3.00/MF $0.75 CSCL 09F

The performance evaluation of the complete telemetry systems (10 links) used for flight testing the SA-6 Saturn vehicle S-1-6 stage and S-IU-6 Instrument Unit is presented. The six telemetry links in the S-1-6 stage and the four telemetry links in the S-IU-6 Instrument Unit have been technically analyzed on an individual basis. Statistical analyses were performed on much of the telemetry data, and the summarized results of these analyses are presented. Author

N65-30624# Bendix Corp., Baltimore, Md. Radio Div.
DEVELOPMENT OF THE AN/FSM-17 EXPERIMENTAL AIRBORNE RADAR TRANSMITTER SPECTRUM ANALYZER Final Report
J. L. McKain et al Griffiss AFB, N. Y., RADC, Mar. 1965 257 p
(Contract AF 33(616)-7574)
(RADC-TR-64-579; AD-466644)

Development of an airborne spectrum analyzer set for pulsed emitters is discussed. The system is capable of measuring three-dimensional radiation patterns of operational high powered radar sets over a frequency range of 400 MH_z to 30 GH_z. Up to ten signals can be simultaneously received and digitally recorded on magnetic tape for later computer analysis. Single channel monitoring of the data recorded provides immediate analog information for on site analysis. The AN/FSM-17 is installed in an Air Force furnished C-131B aircraft and includes an automatic aircraft guidance system. The guidance system will cause the aircraft to fly a course of constant range around the ground antenna or a constant azimuth course away from the site. Precise ground measuring equipment provides the capability of isolating the desired signal frequencies to be measured without requiring the use of aircraft flight time. Manual data reduction and maintenance can be done with either aircraft or ground based prime power. This report describes the development of the AN/FSM-17 system; the acceptance test performed; and the first field task. The report concludes that, in general, the AN/FSM-17 meets all specifications described in R&D Exhibit WCLN 60-7. Author

N65-30668# Radio Corp. of America, Cambridge, Ohio. Communication Systems Div.
CW APPLIQUE TO FM PACK RADIO SETS Final Engineering Report, 22 Jun. 1964–31 Mar. 1965
R. Bigler [1965] 46 p
(Contract DA-28-043-AMC-00217(E))
(CR-65-589-4; AD-616515)

A study was conducted and a design selected for the fabrication of exploratory, developmental model applique units that

provide a Morse-Code capability for pack radio sets. The units constructed were designed for use with Radio Set AN/PRC-10 and Radio Set AN/PRC-25, and do provide a manual Morse-Code transmission and reception capability. Signal strengths of 10 to 12 db below the minimum required for voice transmission provided satisfactory code reception. This is equivalent to nearly a 2:1 increase in range. The study also resulted in the identification of suitable techniques for high-speed Morse-Code transmissions. The development of this capability was not required by the present contract. Author

N65-30710# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HAND RADAR
Oldrich Marko 15 Jul. 1965 4 p Transl. into ENGLISH from Veda A Tech. Miadezi (Czech), no. 8, 1964 p 283
(FTD-TT-65-370/1+2+4; AD-466929)

A miniature radar station to be used by infantry troops is described. It can be carried by one man, weighs 4.5 kg, and detects moving targets up to an approximate distance of 1.5 km. Form, size, speed, and the nature of the object's movement produces an alternating sound at the output. The radar is also equipped with a standard picture (image) screen with dimensions of 25 × 75 mm for aid in detection. The battery power source provides 12 hours of continuous operation. C.T.C.

N65-30713# Weapons Research Establishment (Australia).
SOME SOURCES OF ERROR IN SAMPLED DATA SYSTEMS, WITH PARTICULAR REFERENCE TO TIME DIVISION MULTIPLEXED TELEMETRY
M. J. Malone Dec. 1964 33 p refs
(WRE-TN-ISD-52)

Conventional engineering approximations to the rigid requirements of the sampling theorem can lead under certain circumstances to excessive errors in the output of sampled data systems. The relationships between these errors of approximation and system parameters are developed and guides to consistent system design are outlined. Author

N65-30718*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
ADVANCED ANALOG TELEVISION STUDY Final Report, 4 Nov.–19 Dec. 1963
W. K. Pratt, W. H. Bockwoldt, R. C. Bender, R. D. Quinn, and D. R. Capps [1963] 98 p refs
(Contract NAS9-1564)
(NASA-CR-65034; P63-90) CFSTI: HC $3.00/MF $0.75 CSCL 17B

Various analog techniques for converting a visual presentation into a minimum bandwidth video signal having a minimum susceptibility to video noise were investigated. Insofar as all such methods have some effect on picture quality, the relative effect on viewability of many types of degradation were analyzed. The ability of various television systems to convey the appearance of motion were studied, along with an evaluation of various types of moving image breakup. The multiple interlace system offers decided advantages over other evaluated techniques for use on manned space missions. R.N.A.

N65-30728*# Alabama Univ. Research Inst., Huntsville.
AN APPROXIMATE METHOD FOR THE COMPUTATION OF SCATTERING BY CONDUCTING CYLINDERS WITH ARBITRARY CROSS-SECTION
H. Y. Yee Washington, NASA, Aug. 1965 25 p refs
(Grant NsG-381)
(NASA-CR-282) CFSTI: HC $2.00/MF $0.50 CSCL 17D

The scattering of electromagnetic waves by conducting cylinders with arbitrary cross sections are computed by an approximated method called the point-matching method. The theory is confirmed by low frequency scattering and numerical examples. However, this method is not applicable to the scattering by an infinite strip. The low frequency scattering shows also that for a known scattered field the cross-section of the scatterer can be found. Author

N65-30739# Maxson Electronics Corp., New York.
25 KW TACAN TRANSMITTER ASSEMBLY Final Report
Arnold Rosen Feb. 1965 59 p ref
(Contract FAA-ARDS-630)
(SRDS-RD-64-151; AD-614841)

This report describes the work that was accomplished towards the development of a 25-kilowatt peak power TACAN transmitter using negative grid tubes. A detailed system description is presented in which is discussed the RF amplifier chain, cathode modulation, the feedback loop, reference generator, the frequency exciter and power supply, and the measurement problem. The final section of this report covers conclusions and recommendations. N.E.A.

N65-30793# Mitre Corp., Bedford, Mass.
ERROR CONTROL FOR DIGITAL DATA TRANSMISSION OVER TELEPHONE NETWORKS
Daniel R. O'Neil May 1965 56 p refs
(Contract AF 19(628)-2390)
(TM-04113; ESD-TR-65-87; AD-616678)

This report presents the results of a study of error control techniques applicable to binary digital data transmission over commercial telephone networks. The investigation consisted of a study of error control algorithms, a compilation of the error statistics for digital data on telephone lines, an evaluation of the performance of the error control techniques when applied to these error statistics, and a survey of the state-of-the-art in the hardware development of error control devices. The main objectives of this study have been a determination of the performance to be expected from these error control algorithms when applied to the actual error statistics of common carrier voice bandwidth communication channels and the feasibility of implementing these techniques. An additional purpose of this report is to provide communication engineers and managers with an introduction to the important considerations for selection and evaluation of error control techniques. Author

N65-30800# Ohio State Univ. Research Foundation, Columbus.
DETAILED DATA ANALYSIS OF ECHO I, ECHO II AND MOON REFLECTED SIGNALS. VOLUME I: THE SIGNAL TO NOISE RATIO IMPROVEMENT IN ADAPTIVELY PHASED ARRAYS Interim Report, Jan.–Sep. 1964
S. L. Zolnay and J. W. Eberle Griffiss AFB, N. Y., RADC, May 1965 27 p refs
(Contract AF 30(602)-2166)
(RADC-TR-65-68, Vol. 1; AD-616535)

This report presents the results of a detailed analysis of data collected from January through September 1964 using Echo I, Echo II, and the moon as reflectors of S-band signals. Information is presented, in four volumes, signal-to-noise ratio improvements in adaptively phased arrays and the autocorrelation function of signals reflected from Echo II. Author

N65-30804# Ohio State Univ. Research Foundation, Columbus.
DETAILED DATA ANALYSIS OF ECHO I, ECHO II AND MOON REFLECTED SIGNALS. VOLUME 3: MEASUREMENT OF RELATIVE PHASE DIFFERENCES BETWEEN ELEMENTS OF AN ADAPTIVELY PHASED ARRAY

S. L. Zolnay and J. W. Eberle. Griffiss AFB, N. Y., RADC, May 1965. 20 p. refs
(RADC-TR-65-68, Vol. 3; AD-616533)

This report described a method for measuring the relative phase differences between elements of an adaptively-phased array. A discussion is presented on the need for such measurements, especially from the viewpoints of adaptively phasing an array of transmitting antennas, and the method of measurement is described. The instrumentation of a 27 mc/sec phase detector is given in detail, including an accurate circuit diagram. The experimental results of calibrating the instrument are included. Data obtained on actual Echo-reflected signals show that the adaptively-phased array elements were performing their cohering function. Author

N65-30809# Army Electronics Labs., Fort Monmouth, N. J.
CYBERNETIC AND STATISTICAL CONCEPTS OF ENTROPY AND CORRELATION RELATING TO SYSTEMS ANALYSIS AND SYNTHESIS (PARTITIONS OF DISCRETE INFORMATION SPACES)
Erwin Biser. Apr. 1965. 48 p. refs
(ECOM-TR-2572; AD-615651)

This report deals with an information theoretical model devised to yield the information content of a system by partitioning the system (parameters) into mutually exclusive sets (subsystems). The information content conveyed by the subsystems is then correlated with the information conveyed by the system *as a whole* (the latter is tantamount to observing the system parameters *simultaneously*). The *cybernetic* and *statistical* concepts of *entropy* and *correlation* have a wide application to many systems problems that are amenable to probabilistic models. These concepts can be fruitfully applied to assess and evaluate the degree of *organization* and *disorganization* of systems. The following related topics are also considered in some detail: extension of Shannon's fundamental inequality; the bearing of entropy and correlation on the *analysis* and *synthesis* of systems; *consistency* of information spaces and their underlying *probability spaces*; development of *information correlators* to measure the degree of independence and mutual dependence of the parameters (subsystem) under investigation; the extent to which system parameters can be grouped into disjoint sets (subsystems); partitioning procedures which are often dictated by considerations of economy of time, cost, and effort. Author

N65-30818# Chu Associates, Littleton, Mass.
MULTIPLE PLATE ANTENNA ANALYSIS Final Report, Jan. 1962–Aug. 1964
Robert L. Lagace. [1964] 102 p. refs
(Contract AF 19(628)-297)
(AFCRL-65-171; AD-617710)

Analyses are presented for elements of a multiple plate antenna system capable of providing very large antenna aperture operation in a more economical fashion than present conventional designs. This report presents details of space transmission analyses, design for multiple element systems, and and performance of a feed system specifically designed for the multiple plate antenna. In order to increase system bandwidth, a multiple plate antenna aperture subdivided into smaller multiple plate antenna elements coherently added together by means of a space transmission system was investigated. Theoretical analyses and experimental data are presented for the space transmission system. A high performance feed was synthesized and designed for use with the multiple plate antenna at Strawberry Hill. The feed was developed to give an inverse taper aperture distribution in one plane and a cosine distribution in the orthogonal plane. Coverage from the feed system was designed to illuminate the multiple plate array in an optimum fashion. The synthesis procedure and details of design and performance of the feed system are described in the report. Author

N65-30831# Gottingen Univ. (West Germany). Inst. of Physics.
ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES. PHASE E: HOLLOW WAVEGUIDES WITH COMPLEX IMPEDANCES OF THE WALLS
D. Eisfeld. 1 Mar. 1965. 54 p. refs
(Contract AF 61(052)-667)
(ATSS-10; AD-466935)

A measuring method is described for recording reflection and transmission coefficients in magnitude and phase as a function of frequency in the microwave range. The measuring and a reference signal are marked by different frequency shifting. After being treated in a single channel both signals are equaled in frequency and compared. A hollow waveguide, which guides transverse electromagnetic waves at a certain frequency, is investigated using this device. The waveguide consists of a rectangular duct in which two opposite walls are metallic and the other two are composed of closely stacked resonators. The resonators are tiny waveguides filled with a dielectric and short-circuited at one end. At a certain frequency their input impedance becomes very high, thus the whole resonator wall receives a large surface impedance necessary for guiding the transverse electromagnetic waves. The waveguide is in a narrow frequency band where it is used to measure reflection coefficients at normal wave incidence. The waveguide has a strong dispersion and there is a lower and a higher cut-off frequency where it can be used as a reflection filter for a wide transmission range. R.N.A.

N65-30842*# ADCOM, Inc., Cambridge, Mass.
ADVANCED THRESHOLD REDUCTION TECHNIQUES STUDY First Quarterly Report, 1 Jul.–30 Sep. 1964
[1964] 109 p. refs
(Contract NAS5-9011)
(NASA-CR-64309) CFSTI: HC $4.00/MF $0.75 CSCL 09F

Fundamental aspects of phased-lock loop (PLL), frequency compressive feedback (FCF), band-dividing, and conventional demodulators are investigated to demonstrate the feasibility of reducing the noise threshold for demodulating FM signals. The PLL is characterized as a nonlinear, time-variant system and an analagous analysis is made of the FCF. Absolute lower limit on closed-loop noise bandwidth is established for both demodulators to consider threshold reduction capabilities. The case of the CW signals yields a bandwidth that will not show desirable improvements; sampling and quantizing is also eliminated because of the large number of filters required; sample-and-hold processing is considered a possibility for investigation. Certain published analyses are evaluated, including a quasi-linear model of a PLL demodulator, least squares PLL optimization, and digital simulation of a second order PLL. Higher order phase-locked loop performance, demodulator threshold system design, and an automatic curve plotter are considered. M.W.R.

N65-30854# Polytechnic Inst. of Brooklyn, N. Y. Electrophysics Dept.
RADIATION AND GUIDING IN THE PRESENCE OF A UNIDIRECTIONALLY CONDUCTING SCREEN
Leopold B. Felsen and Alexander Hessel. 16 Mar. 1965. 48 p. refs
(Contract AF 19(628)-2357)
(PIBMRI-1247-64; AFCRL-65-221; AD-616909)

A model method is employed to construct the solution for the fields radiated by a linearly phased electric line current and by an electric current element oriented arbitrarily in a plane parallel to an infinite, unidirectionally conducting screen. In addition to the radiation field which is calculated, these

sources generate surface waves with drastically different behavior for the two types of excitation. This aspect, related to the anisotropy of the surface, is explored and is clarified by the consideration of a source of finite extent which reveals both the quasi-line source and quasi-point source characteristics. The pecularities of surface waves on this anisotropic structure are given detailed consideration and are explained in simple physical terms. The present analysis contains results more general than those published recently in the literature, and it exhibits the connection between certain alternative but quite dissimilar forms of the solution. Author

N65-30855# Harry Diamond Labs., Washington, D. C.
AIRBORNE RADIO BEACON FOR GROUND-IMPACT RECOVERY OPERATIONS Terminal Report
James M. Meek and David T. Lokerson 7 Apr. 1965 45 p refs
(HDL-TM-65-15; AD-616774)

A beacon system has been designed and tested for use in recovering rockets and data stored therein. A miniature radio beacon is carried aloft with the rocket and ejected just before rocket impact. The beacon capsule impacts near the rocket, erects an antenna, and transmits a direction-find signal at 242.00 Mc ±0.005 percent for an estimated 10- to 16-hr period. Tests show that the beacon can withstand rugged flight environment, including high-speed release from altitudes exceeding 1000 ft above ground and subsequent 4000-g impact against rocky terrain. Theoretical aerodynamic and ground-impact investigations were performed, simulated flight and impact tests were conducted, and numerous electronic and mechanical instruments were developed. Author

N65-30863# Ohio State Univ. Research Foundation, Columbus.
DETAILED DATA ANALYSIS OF ECHO I, ECHO II AND MOON REFLECTED SIGNALS. VOLUME 4: THE LONG-TERM AUTOCORRELATION FUNCTION OF ECHO II REFLECTED SIGNALS
S. L. Zolnay and J. W. Eberle Griffiss AFB, N. Y., RADC, May 1965 8 p ref
(RADC-TR-65-68, Vol. 4; AD-616534)

It is concluded that Echo II is apparently rotating in its orbit with a period between 90 and 95 seconds and that the ratio of extreme radii of curvature is 1.03, representing essentially a spherical reflector for the aspect angles involved in the measurement. Author

N65-30864# Harvard Univ., Cambridge, Mass. Cruft Lab.
ANTENNA WITH AN ANISOTROPIC FERRITE SHEATH INSIDE A PARALLEL-PLATE WAVEGUIDE: THEORETICAL AND EXPERIMENTAL STUDIES
B. Rama Rao 1 Mar. 1965 79 p refs *Its* Rept. No. 9, Ser. 413
(Contract AF 19(628)-2406; Grant NSF-GP-851)
(AFCRL-65-336; AD-616912)

Closed form expressions for the current distribution and impedance of an antenna with a magnetized ferrite sheath inside a parallel-plate waveguide have been obtained by a model expansion technique. Numerical results have been obtained with an IBM 7090 computer for applied dc magnetic fields below resonance. Particular emphasis has been paid to studying the following aspects of the problem: (1) the effect of the birefringent properties of the magnetized ferrite sheath on the current and charge distribution of the antenna, (2) the behavior of the antenna at waveguide mode cutoff and at ferromagnetic resonance, (3) the effect of the feed-point singularity on antenna characteristics. In order to verify some of the theoretical predictions, experiments have been made at 1000 megacycles with an Indiana General R-6 Mg-Mn-Al ferrite sample. The experimental results agree qualitatively with theory. A description of the apparatus is included in this report. Author

N65-30881# RAND Corp., Santa Monica, Calif.
DETECTION OF RADAR ECHOES IN NOISE REVISITED
P. Swerling May 1965 82 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4586-PR; AD-616700)

An analysis of mismatched radar detection procedures defined by maximum likelihood, but where the actual received waveform, noise autocovariance, or both, differ from those for which the detection procedure would be maximum likelihood, is presented. The characteristic function of the probability density function of the test variable is derived in the general case and extended to signals having fluctuating amplitudes and phases, pulse to pulse fluctuations, and to the case of complete correlation for the duration of the received waveform on a single scan. A classification of special cases is given with emphasis on generalizations of the Toronto function for some detection probabilities. G.G.

N65-30891# Ohio State Univ. Research Foundation, Columbus, Ohio. Antenna Lab.
DOPPLER AND MONOPULSE TRACKING RECEIVERS FOR THE ADAPTIVELY PHASED ARRAY. VOLUME I: DIFFERENTIAL DOPPLER
Charles Brenner and James Tourdot Griffiss AFB, N. Y., RADC, May 1965 27 p refs
(Contract AF 30(602)-2166)
(RADC-TR-65-66, Vol. 1; AD-617002)

This report presents an analysis of the effect of differential doppler on an array of two elements and an analysis of a monopulse tracking receiver. The results of the differential doppler analysis are presented as a series of graphs providing an insight into the magnitude of this effect and its rate of change. The monopulse receiver analysis includes a detailed discussion of its performance in the presence of noise. Author

N65-30894# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
OUT OF BAND PERFORMANCE OF ANTENNAS
R. W. Lind Griffiss AFB, N. Y., RADC, May 1965 204 p refs *Its* Rept.-65-18
(Contract AF 30(602)-3290)
(RADC-TR-65-43; AD-617123)

This report concerns the out of band performance of antennas. The types covered are cylindrical, biconical, horn and parabolic antennas. Both measured and theoretical data are presented. The antenna parameters covered are radiation and input impedances, gain, and radiation patterns. Author

N65-30901# Toronto Univ. (Ontario). Antenna Lab.
A CRITICAL STUDY OF SOME PROPERTIES OF LINEAR ANTENNA ARRAYS
J. W. Atwood Jun. 1965 75 p refs
(Grant DRB-5540-02)
(RR-37)

A numerical solution is presented to the problem of determining the optimum current distribution in a linear broadside array of 2N or 2N+1 nonisotropic radiators. The solution is useful for arrays of up to two hundred elements. A comparison is made between the beamwidths of a quasi-optimum array which is designed assuming isotropic radiators, but constructed with nonisotropic elemental radiators; and a true optimum array of the same nonisotropic radiators designed using

the numerical solution. The exact optimum distribution does not produce a significant improvement in beamwidth except for arrays of less than fifteen elements. The solution is also useful for arrays of relatively simple radiators having spacings between one half and one wavelength, and for more complicated radiators such as Yagi or other similar directional antennas with spacings up to several wavelengths. A slight modification permits the calculation of the optimum distribution for an array of 2N isotropic radiators with a spacing of less than one half wavelength. Computer programs used are included in the appendix. R.N.A.

N65-30929# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE RELIABILITY OF COMMUNICATION EQUIPMENT AND THE RESULTING DEMANDS ON THE COMPONENT PARTS
K. Freitag 13 Jul. 1965 20 p ref Transl. into ENGLISH from Nachrichtentechnik (E. Berlin), v. 13, no. 1, 1963 p 3–7
(FTD-TT-65-350/1+2+4; AD-466527)

In order to attain safe operations of an instrument and installation it is important to have components that have high standards with regard to reliability and service life. The causes of failure are classified, and the various factors that contribute to increased reliability are reviewed. It is pointed out that methods for increasing the service life of components should be described; and, if this view-point is used as a guide, the problem of increased reliability will be solved. R.W.H.

N65-30981# Research Triangle Inst., Durham, N. C.
ON CROSSINGS OF LEVELS AND CURVES BY A WIDE CLASS OF STOCHASTIC PROCESSES Technical Report No. 4
M. R. Leadbetter Jun. 1965 21 p refs
(Contract Nonr-4565(00))
(SU-181; AD-616762)

In this report, upcrossings, downcrossings and tangencies to levels and curves are discussed within a general framework suitable for application to a variety of problems. The mean number of crossings of a level (or curve) is calculated for a wide class of processes and it is shown that tangencies have probability zero in these cases. This extends a result of Ylvisaker for stationary normal processes, to non stationary and non normal cases. In particular the corresponding result given by Leadbetter and Cryer for normal, non stationary processes can be slightly improved to apply under minimal conditions. An application is also given for an important non normal process. Author

N65-30985# California Univ., Los Angeles. Western Management Science Inst.
DISCRETE SIGNALING AND CODING SYSTEMS Working Paper No. 74
L. Breiman Apr. 1965 38 p
(Contract Nonr-233(75))
(AD-616884)

An elementary exposition of the author's view of information theory. This includes the ideas of block coding, the noiseless coding theorem, channels, accurate transmission over noisy channels, transmission rates, and the noisy coding theorem. Author

N65-30988# Joint Publications Research Service, Washington, D. C.
BACKSCATTER SOUNDING OF THE IONOSPHERE
Nikolay I. Kabanov and Boris I. Osetrov 13 Aug. 1965 110 p refs Transl. into ENGLISH of the book "Vozvratno-Naklonnoye zondirovaniye ionosfery" Moscow, 1965 p 2–112
(JPRS-31541; TT-65-32037) CFSTI: $4.00

In this work we set forth some results of experimental investigations on the phenomenon of long-distance backscattering of short waves from the ground and of the method of backscatter sounding based on the use of this phenomenon. We introduce some of its rules as well as information on the practical application of backscatter sounding, on radar visibility zones (ground–ionosphere–ground at distances from 500–1000 to 3000–6000 km and more). Apparatus and antennas for backscatter sounding stations are described. The book is intended for engineering-technical workers of the radio centers, radio specialists concerned with short wave propagation, and also for students of the VUZ and high schools interested in these problems. Author

N65-31024# Weapons Research Establishment (Australia).
AN AIR–GROUND TELEVISION SYSTEM FOR THE FORMATION FLYING OF RADIO CONTROLLED AIRCRAFT
C. B. Wason Mar. 1965 25 p refs
(WRE-TN-PAD-100)

This note describes the design and performance of an air to ground television system capable of providing continuous coverage within the radio horizon. It has been designed primarily for the purpose of controlling the formation flying of radio controlled aircraft. The link operates in the 800–900 Mc/s band and uses negative amplitude modulation. Author

N65-31036*# Texas Univ., Austin. Defense Research Lab.
MASKING AND BINAURAL PHENOMENA
Lloyd A. Jeffress 14 Jun. 1965 86 p refs Submitted for Publication
(NASA Order R-129; Contracts NObsr-72627; Nonr-3579(04); NObsr-93124)
(NASA-CR-64362; DRL-A-245) CFSTI: HC $3.00/MF $0.75
CSCL 17B

Recent work on the subject of masking, particularly the masking of tonal signals by Gaussian noise, is summarized. Various theories of masking and of auditory function with emphasis on the theory of signal detectability are discussed. The vector theory of binaural unmasking is presented with some discussion of the possible underlying neurophysiological machinery. R.N.A.

N65-31042# Joint Publications Research Service, Washington, D. C.
NOISE IMMUNITY CODES AND REGULAR EXPRESSIONS IN CYBERNETICS
10 Aug. 1965 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Kibernetika i Teoriya Regulir. (Moscow), v. 162, no. 3, 1965 p 516–522
(JPRS-31494; TT-65-31990) CFSTI: $1.00

CONTENTS:

1. CONSTRUCTION AND ANALYSIS OF CYCLIC NOISE IMMUNITY CODES S. I. Samoylenko p 1–6 refs (See N65-31043 19-07)

2. EXPANSION AND APPLICATION OF A REGULAR EXPRESSION TO A BASE M. A. Spivak p 7–10 refs (See N65-31044 19-19)

N65-31043 Joint Publications Research Service, Washington, D. C.
CONSTRUCTION AND ANALYSIS OF CYCLIC NOISE IMMUNITY CODES
S. I. Samoylenko *In its* Noise Immunity Codes and Regular Expressions in Cybernetics 10 Aug. 1965 p 1-6 refs (See N65-31042 19-07) CFSTI: $1.00

A procedure is outlined for construction and analysis of cyclic noiseproof codes using the cyclic properties of quadratic matrices. The requirements of code combination length, error correction, and redundancy are satisfied by this technique, and it permits analysis of the error correction capacity of arbitrary cyclic codes. E.W.

N65-31086# Martin Co., Orlando, Fla.
EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS Eleventh Quarterly Progress Report, 1 Jan.-1 Apr. 1965
J. J. Gallagher, R. G. Strauch, and R. E. Cupp Jun. 1965 32 p refs
(Contract DA-36-039-SC-90753)
(OR-3796; AD-617397)

Ramsey patterns have been observed for the 168.7 Gc lines of hydrogen sulfide for the first time. A pair of interferometers separated by 10 inches was used for the Ramsey excitation. Linewidths on the order of 930 cps, equivalent to 43 at X-band, have been attained. The effects of several sources of line broadening have been observed and are discussed. Author

N65-31088# Naval Research Lab., Washington, D. C.
PREDICTION OF FARADAY ROTATION ANGLES AT VHF AND UHF Interim Report
John M. Goodman 28 Apr. 1965 refs
(NRL-6234; AD-615822)

A study of the Faraday effect has been made and some procedures have been outlined for estimating the amount of Faraday rotation imposed upon linearly polarized radar waves in the ionosphere. The study involves the construction of suitable models for the ionosphere and the geomagnetic field. In the estimation analysis, variable scale height Chapman profiles are used to represent the average ionosphere. The magnetic field model is embodied in a rather standard tabular procedure, which makes use of Navy Oceanographic Office charts. The steps were determined which are required to predict an expectation value for the amount of Faraday rotation imposed upon the radar signals reflected from ionospheric and super-ionospheric targets. These steps involve (a) obtaining a magnetic field parameter from the tabular procedure and (b) estimating the electron content below the target. Both steps (a) and (b) require the knowledge of maximum usable frequencies from Bureau of Standards CRPL maps. Author

N65-31097# Library of Congress, Washington, D. C. Aerospace Technology Div.
TRACKING OF MISSILES AND SPACE VEHICLES Surveys of Soviet-Bloc Scientific and Technical Literature
22 Jul. 1965 77 p refs *Its* Rept. No. 23 Compilation of abstracts
(ATD-P-65-40)

Abstracts are presented on ion clouds and ionosphere perturbations; reflections of electromagnetic waves from the Moon, Sun, planets, and artificial satellites; and radio astronomy (radio emission, antennas, and quantum molecular oscillators). The abstracts cover materials contained in Soviet open literature published during the first ten months of 1964. E.E.B.

N65-31099# Eidgenössische Technische Hochschule, Zürich (Switzerland). Institut für Technische Physik.
APPLICATION OF TELEVISION TECHNIQUE FOR THE PLANIMETRY MEASUREMENT OF COLOR PATTERNS [ANWENDUNG DER FERNSEHTECHNIK FUR DIE PLANIMETRIERUNG FARBIGER VORLAGEN]
Aldo Mandozzi (Ph.D. Thesis) 1964 52 p refs *Its* Publ. No. 12
(Prom-3551)

A combination of television scanning and integration was used for planimetric measurements of patterns and microscopic preparations. Limits for this procedure were established by the scanning theory and the methods of integration, and the theoretical results were used to develop an apparatus able to evaluate black-white and colored patterns with high accuracy and a nonlinear error of 6%. Transl. by G.C.

N65-31136*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
SPACE COMMUNICATIONS: THEORY AND APPLICATIONS. VOLUME 3: INFORMATION PROCESSING AND ADVANCED TECHNIQUES A Bibliography, 1958-1963
Richard F. Filipowsky and Louise C. Bickford, comp. Washington, NASA, Jul. 1965 463 p refs
(Contract NASw-981)
(NASA-SP-7022(03)) GPO: HC $2.50; CFSTI: MF $2.25 CSCL 17B

An annotated bibliography is presented on information processing and advanced communications techniques as part of a four volume bibliography on the theory and applications of space communications. References are included on data processing systems in general; the theory, organization, and operation of computer systems; the engineering of data processing equipment; peripheral devices for data processing in space systems; digital processing methods; analog and hybrid processing methods; simulation by information processing; ground based information processing equipment; information processors in aerospace vehicles; ultra-microwave techniques; optical devices; optical communications systems; potential future communications techniques; and bionics. R.N.A.

N65-31137*# Alabama Univ. Research Inst., Huntsville.
APPROXIMATE METHODS FOR THE COMPUTATION OF WAVE PROPAGATION IN NONUNIFORM MEDIA
H. H. Yee Washington, NASA, Aug. 1965 33 p refs
(Grant NsG-608)
(NASA-CR-283) CFSTI: HC $2.00/MF $0.50 CSCL 20N

Applications of the collocational method to wave propagation through a nonuniform region with variation in only one spatial coordinate are shown for plane and cylindrical cases. Scattering and radiation, in the absence of and in the presence of a similar shaped conducting object are formulated. A simple example shows the accuracy of this method. In cases where the nonuniform region varies in more than one spatial coordinate, Green's function is applied to formulate an integral equation. Solutions of the integral equation can be obtained by an iterative method for small variations. Author

N65-31143*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
APOLLO ENTRY TRACKING: A SHIPBOARD UNIFIED S-BAND INTERFEROMETER SYSTEM
F. O. Vonbun Washington, NASA, Aug. 1965 28 p refs
(NASA-TN-D-2880) CFSTI: HC $2.00/MF $0.50 CSCL 17B

An outline of the re-entry tracking and communication problem, including a possible solution, is presented in this paper. The acquisition of the lifting Apollo spacecraft after i

enters the earth's atmosphere is a difficult problem for tracking which requires particular attention. An interferometer especially developed for this purpose is described and the major design parameters are given. A re-entry network configuration is presented, and the necessary tracking tasks outlined. Blackout problems, re-entry trajectory ground tracking errors and the best ship positioning are discussed in detail. Author

N65-31173# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE TWO-FREQUENCY MEASUREMENT OF LINE-OF-SIGHT SPREAD CHANNELS
M. L. Burrows 17 May 1965 29 p
(Contract AF 19(628)-500)
(TN-1965-9; AD-616528)

An analysis is carried out of the effects of various non-ideal circumstances on the two-tone method of measuring the two-frequency correlation function $R(\Omega,\tau)$ for microwave line-of-sight communication channels. These circumstances are the presence of both short-term and long-term instabilities of the signal sources, the presence of additive noise, and the use of discontinuous tones such as those available from a spinning satellite. It is shown that oscillator instability effects are removable by assigning the short-term carrier oscillator instabilities to the channel, using high quality modulating oscillators and including phase-lock tracking loops, that the effect of additive noise can be made negligible provided the signal-to-noise power ratio of the received tones is greater than about 6 db, and that the use of discontinuous slowly-switched tones is distinctly disadvantageous. A method of processing the received tones is suggested which automatically removes the large constant delay due to range, leaving only the frequency dependent part of the delay. Author

N65-31198# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A CERTAIN NONPARAMETRIC DEVICE FOR THE DETECTION OF BINARY (RADAR) SIGNALS
J. L. Kulikowski 15 Jul. 1965 16 p refs Transl. into ENGLISH from Arch. Elektrotech. (Warsaw), v. 13, no. 1, 1964 p 15–24
(FTD-TT-65-365/1+2+4)

The principles of operation of a radar signal detection device based on the nonparametric statistical tests are described. The case of signals of unknown similarity density functions belonging to the Markov processes class is discussed. Pearson X^2 test is also considered. Author

N65-31225# Gt. Brit. Dept. of Scientific and Industrial Research.
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF MARCH 1965 AND SUPPLEMENTARY LIST FOR NOVEMBER 1964
[1965] 37 p

N65-31228# RCA Service Co., Inc., Patrick AFB, Fla.
THE ACCURACY OF ETR INSTRUMENTATION
C. S. Cummings, R. H. Ackerson, A. S. Baron et al May 1965 451 p refs Prepared for Pan Am. World Airways, Inc. Sponsored by AF Supersedes MTC-TDR-64-1; see X64-13073 (ETR-TR-65-7; MTC-TDR-64-1; AD-616897)

The annual summary statements of the accuracy of Eastern Test Range Tracking Instrumentation are presented in this report. The report also provides brief system descriptions and a detailed discussion of the definition of errors encountered in tracking system evaluations, methods and techniques used to estimate errors, error sources, specific ETR methodologies including data analysis flow diagrams and a discussion of the variance–covariance error propagation required to determine the accuracy of reduced position, velocity and acceleration data. Work on the determination of instrumentation accuracy is a continuing project and revisions and refinements to the estimates of accuracy are issued periodically as additional information is made available. Author

N65-31231# Lincoln Lab., Mass. Inst. of Tech., Lexington.
COMMUTATING FEED FOR CIRCULAR ARRAY ANTENNA AND ITS APPLICATION TO THE LES Technical Note No. 1965-19
J. B. Rankin 24 May 1965 18 p
(Contract AF 19(628)-500)
(ESD-TDR-65-225; AD-616986)

A commutator for a circular antenna array is described using multi-throw switches fed in parallel through a power divider. The excitation phases of the elements can be controlled by phasing elements located between the power divider and the switches. In applications requiring excitation of only a few radiators at a time, each phasing element might simply be a diode together with tuning reactances. Application of the commutator and phasing scheme to a step-scanned antenna for LES-5 or 6 is described. Author

N65-31236# Gt. Brit. Dept. of Scientific and Industrial Research. Radio and Space Research Station.
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY PREDICTION SERVICE FROM MALTA: JANUARY AND FEBRUARY 1965
1965 51 p *Its* Issue 8

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-30225 Joint Publications Research Service, Washington, D. C.
ON THE BASIC ALGORITHMIC LANGUAGE
E. I. Yustchenko and A. E. Kulynkovich *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 4–15 refs (See N65-30225 19-10) CFSTI: $6.00

The development of algorithmic languages and automatic programming systems through perfection of the computer input and output devices is discussed. The following programming processes for algorithmic texts are considered: (1) optimizers; (2) programming programs; (3) specializers; (4) analyzers; and (5) processors of higher ranks. An address language based on the relationships of addressing was found satisfactory to describe algorithms of a computer character, as well as algorithms for processing textual information. It is pointed out that a higher level of algorithmic language requires less specialized computer technology knowledge for composing an algorithmic text. A basic outline for the development of algorithmic languages is included. G.G.

N65-30236 Joint Publications Research Service, Washington, D. C.
ON DATA SORTING BY MEANS OF MAGNETIC TAPES
S. B. Pogrebinskiy and L. S. Lozinskiy *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 136–149 refs (See N65-30225 19-10) CFSTI: $6.00

Digital computer data sorting methods using start–stop tapes are compared with methods using continuous motion tapes. The average speed of information exchange by start–stop magnetic tapes was found to be tens of thousands bits per second as compared to hundreds of thousands bits for a continuously moving tape. An algorithm for two-stage sorting is also presented that reduces the time for sorting blocks where words with completely coinciding indices are not present. Two-stage sorting can also be used for blocks containing words with coinciding indices if their common index is of small magnitude. G.G.

N65-30237 Joint Publications Research Service, Washington, D. C.
PROPOSAL ON CONTEXT-FREE LANGUAGES IN PUSH-DOWN MEMORY AUTOMATA
A. A. Letichevskiy *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 150–158 refs (See N65-30225 19-10) CFSTI: $6.00

Context-free languages are discussed as a solution for special equation systems, and the characteristic properties of these languages are determined in terms of algebraic events. The results are used to form algorithms for synthesis and analysis of automata for context-free languages, and also to present a definition for computers with push-down memory that corresponds to the abstract theory of automata. G.G.

N65-30243# Mitre Corp., Bedford, Mass.
PAT, A LANGUAGE FOR PROGRAMMING AND MAN–COMPUTER COMMUNICATION
R. Silver and C. Wells Bedford, Mass., AFSC, Electron. Systems Div., Jun. 1965 35 p refs
(Contract AF 19(628)-2390)
(W-07191; ESD-TDR-64-636; AD-617344)

PAT is a computer language of the macro-assembly type. The program, which translates PAT into computer code, is designed to be used not only as a compiler of programs, but as a symbolic interface between a user and a computer. In this latter capacity, it can serve to interpret commands and accept command definitions for such programs as a text editor, on-line debugger, or simulated desk calculator. The language and the translator have been designed to allow the structure of the translator itself to be modified by certain definitions encountered during the translation process. The rules for defining symbols and referring to them have been organized to facilitate combining independently written programs into a single unit. Author

N65-30261 Joint Publications Research Service, Washington, D. C.
PROGRAMS WITH VARYING SEQUENCE OF EXECUTION OF CYCLES
T. M. Ter-Mikaelyan *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 246–259 ref (See N65-30250 19-10) CFSTI: $7.00

This article describes a method of compiling a standard program for successive implementation of one and the same computational scheme by means of a computer, in which the sequence of execution of cycles (the sequence of their "embedding") varies. Section 1 describes the problem leading to such a computational scheme and Section 2, the method of compiling programs of this kind. Author

N65-30266 Joint Publications Research Service, Washington, D. C.
A METHOD OF TEXT ANALYSIS
G. V. Vakulovskaya and O. S. Kulagina *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 357–364 refs (See N65-30250 19-10) CFSTI: $7.00

Refinements are considered for a method of text analysis which consists in the production of different admissible variants of analysis for each individual sentence. An admissible variant is construed of a pair of words (referred to as controlling word-controlled word) which realize a certain configuration in a table and which are disjoint and do not form closed cycles. Purges are carried out in the initial matrix with respect to the verb, preposition, rows with a single-unity element and with several 1's, and diagonal elements. Conditions for variant selection are stipulated; a variant is discarded if its relations do not satisfy the conditions written in the tables. Results are presented for a computer experiment with a Russian mathematical text of 80 sentences made up of fragments from four authors. M.W.R.

N65-30268 Joint Publications Research Service, Washington, D. C.
PATTERN RECOGNITION ALGORITHM FOR A CLASS OF AUTOMATIC LANGUAGES
A. V. Gladkiy *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 370–373 refs (See N65-30250 19-10) CFSTI: $7.00

A theorem is proved by induction for the existence of a pattern recognition algorithm for the entire class of automatic grammars for which the basic and auxiliary vocabularies are disjoint finite sets. The relationship between arbitrary language and the construction of automatic grammars are considered in two lemmas from which the theorem proof is induced. M.W.R.

N65-30347# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center.
MATHEMATICAL AUTOMATA THEORY. VOLUME I: FINITE AUTOMATA Final Report
C. C. Elgot, J. Mezei, J. Thatcher, E. Wagner, and J. Wright Griffiss AFB, N. Y., RADC, May 1965 149 p refs
(Contract AF 30(602)-3340)
(RADC-TR-65-113, Vol. I; AD-617404)

These two volumes constitute the final report on the research on mathematical automata theory. Three broad areas were investigated: (1) the use of formal languages to describe the nature and behavior of finite automata; (2) the development of algebraic approaches to the description of finite automata, automata behavior, and the classification of automata; (3) the development of global models (models that, in effect, consider a "digital computer" as-a-whole) and computability theory. Author

N65-30348# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center.
MATHEMATICAL AUTOMATA THEORY. VOLUME II: GLOBAL MODELS AND COMPUTABILITY THEORY Final Report
C. C. Elgot, J. Mezei, J. Thatcher et al Griffiss AFB, N. Y., RADC, May 1965 172 p refs Submitted for Publication
(Contract AF 30(602)-3340)
(RADC-TR-65-113, Vol. II; AD-617410)

The results of several investigations into the properties and languages of mathematical automata, which serve as overall models of computers, are given. The Turing machine is discussed as a global model, and the relationships between the theory of these machines and the theory of finite automata are considered along with their relationship to digital computers. A new global model, the machine species, is also discussed, and formal languages describing computations of these species are given. A means of constructing uniformly reflexive structures on arbitary domains is examined, and highly constructible uniformly reflexive structures are studied in detail. The concept of

many-one reducibility for functions is presented, and particular attention is paid to the properties of the maximal functions (and sets) under the ordering induced by many-one reducibility. C.T.C.

N65-30445# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RAPID ACTION OF STEP-BY-STEP AUTOMATIC SEARCH SYSTEMS SITUATED UNDER THE EFFECT OF INCIDENTAL INTERFERENCES
B. A. Besedin and G. A. Medvedev 15 Feb. 1965 15 p refs
Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Tekhn. Kibernetika (USSR), no. 2, 1963 p 70–77
(FTD-TT-64-520/1+2; AD-611521)

Mean value and time dispersion formulas for the change over of a step-by-step automatic searching system from one state to another have been derived for cases having a finite number of states. Systems of equations for determining mean transition time and dispersion of conversion time are presented, and modifications are included for instances where the number of possible states appears to be unlimited. A special case with lump-linear characteristics and an unlimited number of possible states is considered, and a comparative analysis of two structurally different systems is appended. M.W.R.

N65-30616# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
PATTERN RECOGNITION
R. Bianchini and M. Shostak 15 Dec. 1964 92 p
(Contract AT(30-1)-1480)
(NYO-1480-19)

Report is made of a character recognition study and development of a digital computer input device for reading and translating handprinted FORTRAN programs. Based upon a 2000-specimen library, computer recognition programs were written to partition the 40 alphanumeric character classes used as input into a total of 20 classes with an accuracy of slightly over 90%. Further refinement of methods used in this study would probably lead to full 40-class partition, with an accuracy of about 90%. Author

N65-30674# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
DIFEQ INTEGRATION ROUTINE–USER'S MANUAL. MATHEMATICS
R. E. Moore, J. A. Davison, H. R. Jaschke, and S. Shayer 18 Feb. Feb. 1964 47 p refs
(LMSC-6-90-64-6; AD-616917)

The purpose of the paper is to describe the use of a novel program, DIFEQ, written for the IBM 7094 computer, for 'solving' systems of ordinary differential equations, that is to say, for finding numerical values of particular solutions with assigned initial conditions. TAB

N65-30708# Illinois Univ., Urbana. Coordinated Science Lab.
THE LOGIC ORGANIZER AND DIAGNOSIS PROGRAMS
Sundaram Seshu Jul. 1964 90 p refs
(Contracts DA-28-043-AMC-00073(E)); AF 49(638)-1383)
(R-226; AD-605927)

This report is divided into two parts. The first part is a user's manual for those wishing to use the system of programs for the diagnosis of sequential switching circuits. The second part is a programmer's manual. Here detailed descriptions of the individual subroutines, including calling sequences and peculiarities are given. This system of programs was developed as a tool in the experimental study of self-diagnosis in electronic digital computers. The system consists of two programs—the organizer (5000 instructions) and the sequential circuit analyzer (10,000 instructions) with about 1500 instructions in common. The organizer is a program for arranging the logic in levels and identifying any feedback loops not identified in the input. The sequential circuit analyzer is a program for producing the testing procedure for any given sequential circuit. The organizer prepares the input for the analyzer. The entire system is written in machine language for the CDC 1604 computer and uses the Illinois system subroutines for input-output. Author

N65-30762# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.
RESEARCH ON THE APPLICATION OF FERRO- AND FERRIELECTRIC PHENOMENA IN COMPUTER DEVICES Final Report, Aug. 1962–Oct. 1964
Charles F. Pulvari Feb. 1965 77 p refs
(Contract AF 33(657)-8871)
(RADC-TR-64-529; AD-614010)

The discovery of the ABO_3 type or perovskite type ferrielectrics exhibiting a threshold switching field and the valuable results gained during the first phase of this investigation permitted the extension of work to find new materials exhibiting similar properties. This led to the discovery of a second class of ferrielectrics, the MBO type of Mixed Bismuth Oxides type ferrielectrics, with highly useful electrical and technological properties. The objective of this research was to demonstrate that capacitor elements composed of ferrielectrics of the MBO type employed as a dielectric represent an important improvement as compared to ordinary ferroelectric capacitors and that they can be utilized as a logic and memory device. Author

N65-30801# Hughes Aircraft Co., Fullerton, Calif.
ASSOCIATIVE PROCESSING TECHNIQUES STUDY Final Report, 1 Jan.–31 Dec. 1964
H. H. Love and D. A. Savitt Griffiss AFB, N. Y., RADC, Apr. 1965 163 p refs
(Contract AF 30(602)-3279)
(FR-65-11-18; RADC-TR-65-32; AD-616620)

The concept of a general-purpose computer, called the Association-Storing Processor (ASP), is defined, and a model computer, based upon the concept, is described. The computer characteristics of simplified programming and efficient processing of non-numerical problems were the dominating considerations in the ASP concept development. The concept is concerned with a way to represent data and to state problem procedures, along with a corresponding algorithm for obtaining problem solutions. The data representation of the ASP concept is based upon the idea of explicitly storing the nature of the association between data items, together with the associated items, as a data relation. A data structure is created with this data relation as the basic element of data, and data items are addressed by their context of relations within the structure. Author

N65-30811# System Development Corp., Santa Monica, Calif.
ALGORITHMIC LANGUAGES PROJECT Final Report, 1 Jun. 1962–15 Aug. 1964
Seymour Ginsburg Bedford, Mass., AFCRL, 3 Feb. 1965 13 p refs
(Contract AF 19(628)-485)
(TM-738(012)00; AFCRL-65-169; AD-615660)

The purpose of this algorithmic languages project was to accomplish the following: 1) conduct research designed to

develop a theory for algorithmic (programming) languages, 2) develop sutiable mathematical models of currently used mathematical languages such as ALGOL, COBOL, and JOVIAL, and, 3) use the mathematical models to answer questions of interest about these languages. Findings presented in previous volumes in this series are reviewed and summarized.
Author

N65-30936# Burroughs Corp., Paoli, Pa.
MOD III COMPUTING SYSTEM, LAUNCH SUPPORT TEST PROGRAMS, EASTERN TEST RANGE. COMBINED SYSTEMS TEST PROGRAM, CLASS IV
J. Bradley, A. Goldman, P. Janes, and O. Orvis 30 Jun. 1965 73 p refs
(Contract AF 04(695)-690)
(Rept.-4411-65-242; AD-468230)

Presented are data on the general configuration of the Combined Systems Test (CST) computer program and its operating features which are utilized in support of Gemini launch vehicle testing. Described are CST program control routines and functions, minus-time routines, plus-time routines, data displays and recording, and operating requirements. S.C.W.

N65-30937# Burroughs Corp., Paoli, Pa. Defense, Space and Special Systems Group.
MOD III COMPUTING SYSTEM, LAUNCH SUPPORT PROGRAM REPORT, EASTERN TEST RANGE. REAL TIME DATA REMOTING PROGRAM, CLASS III
J. Bradley, L. Feldsher, A. Goldman, and M. Lasoff 21 Jul. 1965 47 p
(Contract AF 04(695)-690)
(Rept.-4411-65-244; AD-468231)

The Real Time Data Remoting program and its individual routines are described. The program provides a data remoting capability for use in system checkouts and operator proficiency tests. Predetermined data and events are supplied in real time to the computer by means of specially prepared input and intermediate tapes. The requirements and formats of these tapes are presented. Appendices contain a glossary of terms, explanatory program flow charts, and the program listing. R.N.A.

N65-30952*# National Aeronautics and Space Administration, Washington, D. C.
FUNDAMENTALS OF COMPUTER TECHNOLOGY
Ye. A. Drozdov, V. L. Prokhorov, and A. P. Pyatibratov Aug. 1965 459 p refs Transl. into ENGLISH of "Osnovy Vychislitel'noy Tekhniki" Moscow, Voyenizdat, 1964
(NASA-TT-F-349) CFSTI: HC $5.00/MF $2.25 CSCL 09B

The design principles of electronic computers, and the fundamentals of preparing problems for solution on computers (elements of programming) are presented. The material on elements, assemblies, and individual units of the computers was updated and the technology and symbols were also revised. The hardware and operating principles of general-purpose and special-purpose digital computers are described. All stages of programming, writing, reading, converting, coding, storing, and controlling are explained, including the underlying physical, electronic, and mathematical principles. Numerous wiring diagrams, timing charts, block diagrams, hysteresis loops, and programming samples are given, and merit comparisons of different types of functional blocks were made. R.W.H.

N65-30980# Naval Missile Center, Point Mugu, Calif. Systems Evaluation Office.
FORTRAN PROGRAM FOR PLOTTING TWO-DIMENSIONAL GRAPHS
R. G. West and J. R. Reynolds 21 Jun. 1965 18 p
(NMC-TM-65-31; AD-616730)

A computer program written at the U.S. Naval Missile Center in FORTRAN IV language enables users to plot two-dimensional graphs with the standard output printer during the execution phase of any FORTRAN IV or MAP (machine language) main program. Although this program was written primarily for the IBM 7090 and 7094, the versatility of the FORTRAN IV computer language makes the program easily adaptable for use in many other computers, thus saving labor and time. The program description is given in this report for those who do not have access to computer libraries. This FORTRAN program consists of three subroutines, GRAPH, PACK, and PLACE; and one that is optional, SELECT. Subroutine GRAPH incorporates PACK and PLACE, which are MAP subroutines. These two MAP subroutines conserve computer storage and time required to print the output of the program. Subroutine SELECT is used to define the beginning and end points of the graph scale. If SELECT is not used, the minimum and maximum scale values for the axes must be defined in the main program.
Author

N65-31025# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ANALOG COMPUTER METHODS FOR PARAMETER OPTIMIZATION
R. A. Harvey, G. R. Taylor, and R. D. Benham Jun. 1965 34 p refs
(Contract AT(45-1)-1830)
(BNWL-70)

Techniques are described for the optimization of mathematical model parameters with analog computers. The methods used appear general in nature and applicable to a wide variety of problems. A quadratic performance index was used. Hence straightforward servomechanism feedback techniques could not be based directly on the performance criteria index. Every other computing cycle was used to perturb a parameter of the system so that measures of parameter influence coefficients were determined which served as the feedback signal. The principle of optimality was applied in that for the slower changing parameters, the faster ones were always maintained at their optimum values. The number of timing devices required is the same as the number of interacting parameters being optimized. The master and the slave timing devices were used to determine the parameter influence coefficients for the performance. The utilization of timing devices in this manner assumes that the parameters are interacting. E.E.B.

N65-31046*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
METHODS OF FITTING MULTIVARIANT FUNCTIONAL MODELS IN THE AREA OF LARGE COMPUTER EXPLOITATION Final Report, 23 May 1963–23 Jul. 1965
I. E. Perlin, O. B. Francis, Jr., J. J. Goode, D. E. Peterson, and J. W. Walker 1965 248 p
(Contract NAS8-5365)
(NASA-CR-64419) CFSTI: HC $6.00/MF $1.50 CSCL 09B

The fitting of multivariant functional models in the area of large computer exploitation is considered. A balanced polynomial design model was studied. It was shown that the least square fit which involved the inversion of a large order matrix could be reduced to the inversion of many small order matrices. To overcome the objection of the tremendous number of data points, a step-up orocedure was developed. The procedure starts with a model which assumes the guidance function as a linear combination of n terms(not necessarily polynomials). The procedure attempts to select a subset k of the n terms which best fit the observational data in the sense of least squares. Preliminary experience indicated that efficient stopping

and throwout criteria depended on the class of problems under consideration. Data were analyzed and the step-up procedure applied to the fitting of the guidance functions. Also, in order to gain insight into the synthesis problem, the flat earth problem was studied and a graphical synthesis developed. The studies indicate that the stepwise regression procedure shows considerable promise in the fitting of multivariant functional models. E.E.B.

N65-31066# Burroughs Corp., Paoli, Pa. Defense and Space Group.
MOD III COMPUTING SYSTEM, LAUNCH SUPPORT PROGRAM REPORT, EASTERN TEST RANGE. T-15 MINUTE TARGETING PROGRAM, CLASSES II AND IV
J. Bradley, L. Feldsher, A. Goldman, and N. Siecko 30 Jun. 1965 38 p ref
(Contract AF 04(695)-690)
(Rept.-4411-65-240; AD-467784)

The use and operation of the T-15 Minute Targeting Computer program for use on Gemini project is described. To transmit, receive, and verify data exchanged between the Mod III system and MCCH (Mission Control Center-Houston), the T-15 program is divided into two phases: (1) the transmittal of the initial message from MCCH to the Mod III system upon program request, verification of the transmittal, and derivation of the switch constants corresponding to the AED (Agena ephemeris data) and their display in the accumulator lower register (ALR); and (2) the reassembly of the data from the switch memory, the transmission of the data to MCCH, and the verification of complete compatibility with the original information. R.W.H.

N65-31155# Oak Ridge National Lab., Tenn. Health Physics Div.
FORTRAN AND CODAP LISTINGS FOR ZAP-1. (A CDC-1604 COMPUTER PROGRAM TO CALCULATE RADIATION DOSE NEAR A SPHERICAL SOURCE)
P. A. Thompson, S. A. Lewis, and T. G. Clark Nov. 1964 28 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-817)

A FORTRAN 62 and CODAP-1 program, ZAP-1, has been written for the CDC-1604 computer for the calculation of depth dose in tissue from a nearby spherical radioactive source. This report presents the listings for the ZAP-1 program. Author

N65-31172# Office of Aerospace Research, Washington, D. C.
INFORMATION SCIENCES 1964
Harold Wooster Mar. 1965 129 p refs
(AFOSR-65-0271; AD-616883)

This book is a report on the research program sponsored by the Directorate of Information Sciences of the Air Force Office of Scientific Research during 1964. The research program is divided into six tasks: information systems research; information extraction and classification; transmission of information; adaptive and self-organizing systems; language and linguistic research; and theoretical foundations. TAB

N65-31210# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE NRU MONITOR COMPUTER AND SELF-POWERED NEUTRON FLUX DETECTORS
K. R. Morin May 1965 50 p refs
(AECL-2216) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.50

This report describes the part played by the PDP-5 in the real-time dual computer system at the NRU reactor. Particular attention is paid to the computer usage of self-powered neutron flux detectors. The PDP-5 input–output equipment is described. The program organization is outlined, and the use of the program interrup, establishment of priorities, and interlacing of printouts are discussed. The multiplexer programs are described in detail, including alarm printouts and the introduction of hysteresis into the digital alarm levels. The flux detector programs are described, including background corrections and the daily recalibration of the sensitivity factors. The detailed mathematics used with the rhodium detectors is given. Some alternatives to using a computer to follow the detectors' decrease in sensitivity are outlined. Details of program sizes and execution times are given. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-30197# TRW Semiconductors, Inc., Lawndale, Calif.
TRANSISTOR, VHF, SILICON, POWER (50 W-150 mc) Final Report, 1 Jul. 1963–30 Jun. 1964
S. H. Barnes, M. O. Preletz, and B. Rappaport [1964] 105 p
(Contract DA-36-039-AMC-02355(E))
(TRW-S-46-RD-F; AD-615127)

The development of a 50W-150mc transistor is described. The transistor was designed on the principle of paralleling a group of small transistor cells to build up to the required power. Three basic designs were made in the course of optimizing the RF and thermal performance of the device. Equalizing the base feed to each cell was determined to be a critical factor in getting all the cells to work together. In fabricating the transistors, two new processes were used. The first was the evaporation of metal contacts over oxide layers in sufficient thickness to conduct the required current. The second was the deposition of oxide layers by the decomposition of ethyl silicate which served to preclude holes in the grown oxide layers due to imperfections in the photoresist masks or other causes. A beryllia disk package was used for the transistor samples. With the 50W-150mc transistor crystal the package was shown to be capable of dissipating 125 watts. R.N.A.

N65-30198# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
SMALL SIGNAL FUNCTIONAL CIRCUITS Quarterly Progress Report, 1 Oct.–31 Dec. 1964
James Feit [1964] 33 p
(Contract DA-28-043-AMC-00150(E))
(QPR-2; AD-615125)

Breadboard designs for linear integrated front end circuits for use in army manpack FM radio receivers were evaluated for performance. An RF amplifier, first oscillator, second oscillator, and mixer circuit were selected for fabrication. The RF amplifier uses a direct coupled common emitter-common emitter stage; the first oscillator employs a positive feedback from collector to emitter; the second oscillator employs a grounded collector configuration; and the mixer circuit is basically a common emitter stage biased so that conduction is established by the local oscillator injection. L.S.

N65-30248# Sperry Rand Corp., Blue Bell, Pa. UNIVAC Engineering Center.
MEDIUM-SPEED MASS RANDOM-ACCESS MEMORY Final Report
C. Chong, G. Reid, and A. Turczyn Griffiss AFB, N. Y., RADC, Mar. 1965 132 p refs
(Contract AF 30(602)-3430)
(RADC-TR-64-571; AD-615493)

A feasibility study of a medium-speed, nonmechanical, mass random-access memory has been completed. The memory is to have a capacity of up to 10^8 bits at a cost of less than 1 cent per bit. The memory element chosen for this application is the magnetic thin-film plated wire operated in the nondestructive readout mode. Theoretical and experimental investigations have been made of the word and bit lines. Construction techniques have also been investigated. A preliminary design of the memory based on these investigations has been completed. Author

N65-30280# Joint Publications Research Service, Washington, D. C.
IZVESTIYA VUZov: RADIO ENGINEERING, VOL. VIII, NO. 2, 1965
6 Aug. 1965 208 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedenii, Radiotekhn. (Kiev), v. 8 no. 2, Mar.–Apr. 1965 p 131–286
(JPRS-31446; TT-65-31942) CFSTI: $6.00

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N65-30281 Joint Publications Research Service, Washington, D. C.
INSTABILITY OF THE CURRENT DISTRIBUTION AND THE RELIABILITY PROBLEM IN TRANSISTOR ELECTRONICS
N. M. Royzin *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 1–30 refs (See N65-30280 19-09) CFSTI: $6.00

Analyzed are the conditions at which the current distribution in transistors and transistor circuits is unstable. In some cases this leads to an overloading of individual transistors. At that time, the conditions of internal stability may become disturbed and the current in the transistors may be reduced to a sheath. The main object of this article concerns the reliability of transistors, but the investigation made here has wider implications: it applies also to the instability of media with negative conductivity (or resistivity) among which the transistor is but one specific example. Author

N65-30282 Joint Publications Research Service, Washington, D. C.
SILICON CONTROLLED RECTIFIERS OF THE p-n-p-n TYPE
Yu. V. Serdyuk and Ya. K. Trokhimenko *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 31–51 refs (See N65-30280 19-09) CFSTI: $6.00

A discussion is presented on p-n-p-n type silicon controlled rectifiers, their basic characteristics, and application in circuits. The rectifiers perform the function of electronic relays and are superior to electromagnetic relays with respect to speed of response, sensitivity, mechanical simplicity, and reliability. They are smaller in weight and size than gas-filled tubes, have longer life, operating frequency, mechanical stability, and reliability. They can operate at lower voltages and require no warm up time. The rectifiers also make it possible to attain higher efficiency, since there is no filament and the conducting resistance is low. Unlike transistors operating as switches, they do not require a continuous input signal. Their power losses are also lower. Schemes using the silicon controlled rectifiers were analyzed but only give a rough idea of possible applications. Improvements in their temperature and frequency characteristics will broaden their application to heavy power switching, current and voltage conversion, logic circuits, and to special circuits such as semiconductor analogs of inductance. R.N.A

N65-30283 Joint Publications Research Service, Washington, D. C.
ON THE DEPENDENCE OF GAINS ON THE CURRENT IN p-n-p-n TYPE DEVICES
V. A. Kuz'min and O. R. Mochalkina *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 52–59 refs (See N65-30280 19-09) CFSTI: $6.00

An analysis is made of triode structures, components of p-n-p-n diodes, also the dependence of α on the emitter current in a wide-base silicon transistor. Established is the effect which the derivative of α with respect to current has on the switching voltage of a p-n-p-n diode. Author

N65-30284 Joint Publications Research Service, Washington, D. C.
TRANSIENT PROCESS FOR THYRISTOR SWITCH-ON
A. I. Gomonova and L. N. Kaptsov *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 60–73 refs (See N65-30280 19-09) CFSTI: $6.00

A step-by-step analysis is carried out for the transient process of thyristor switch-on by a controlling current pulse. The effect of the current dependence of the current transfer coefficient in a wide-base thyristor on the nature of the increase in anode current is shown. Formulas are obtained for calculating the growth rate of the current and the delay time. Author

N65-30285 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF SWITCHING TIME OF A DYNISTOR WITH ACTIVE LOAD
V. I. Vaganov and V. S. Pershenkov *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 74–86 refs (See N65-30280 19-09) CFSTI: $6.00

The switching time of a dynistor with active load is analyzed on the basis of a proposed equivalent dynistor circuit in the form of a sequential combination of a nonlinear voltage generator and inductance. The cases of slow and rapid variation of the input signal are considered. Working relationships for the delay time and front are obtained for forward and reverse switching. Author

N65-30286 Joint Publications Research Service, Washington, D. C.
SINGLE-STAGE AMPLIFIERS WITH DYNISTORS
I. I. Shagurin *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 87–103 refs (See N65-30280 19-09) CFSTI: $6.00

Two types of amplifiers are considered using a dynistor as the active element. An analysis of the stability of the amplifier is carried out, the region of intermediate and high frequencies and the stability of the gain are considered. The results of the analysis are confirmed experimentally. Author

N65-30287 Joint Publications Research Service, Washington, D. C.
SPACE RECOMBINATION IN A TRANSISTOR FOR AN ARBITRARY INJECTION LEVEL
Yozef Shikula *In its* Izv. VUZov: Radio Engineering Vol. VIII, No. 2, 1965 6 Aug. 1965 p 104–116 refs (See N65-30280 19-09) CFSTI: $6.00

Space recombination is described in a transistor base for arbitrary concentrations of the minority charge carriers. Recombination is considered in a space having a nonequilibrium carrier density which linearly varies in one direction. A differential equation is introduced describing the distribution of the charge carriers in the base taking into account the recombination losses and a graph of its solution is given on an electrointegrator. The recombination losses in the transistor base are described as a function of the recombination intensity, the parameter χ and the relative concentration. Author

N65-30288 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF SURFACE VARACTORS WITH A STRUCTURE OF TITANIUM-SILICON METAL-DIOXIDE
V. V. Kuznetskiy, N. G. Nifontov, Yu. R. Rodionov, and V. V. Rudnev *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 117–129 refs (See N65-30280 19-09) CFSTI: $6.00

Methods and results of investigations of surface varactors with a titanium-silicon metal-dioxide structure are described. The capacitance, loss resistance, and quality are given as functions of the frequency of a sinusoidal signal and of the magnitude and sign of the grid bias. Author

N65-30289 Joint Publications Research Service, Washington, D. C.
ELECTRONIC RELAYS BASED ON NONLINEAR CIRCUITS WITH p-n-JUNCTION CAPACITANCE
V. K. Dushchenko *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 130–141 refs (See N65-30280 19-09) CFSTI: $6.00

The article deals with bistable elements based on nonlinear circuits with p-n junction capacitance. The possible operating modes of such circuits are established and recommendations for selecting elements are made. A circuit with a counter input is proposed. The creation of high-speed transistorized flip-flops results in certain design problems even at frequencies of the order of a few megacycles, though at the present time devices operating at considerably higher frequencies are required. Reasonably adequate circuits in this respect have been created by using tunnel diodes, though the tunnel diode, a device with negative resistance does not itself ensure high operating stability. Author

N65-30290 Joint Publications Research Service, Washington, D. C.
FREQUENCY-MODULATED TUNNEL-DIODE OSCILLATORS
B. M. D'yachenko *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 142–155 refs (See N65-30280 19-09) CFSTI: $6.00

Frequency-modulated oscillators utilizing one and two tunnel diodes are investigated theoretically and experimentally. A comparative evaluation of them is given from the standpoint of the feasibility of achieving frequency modulation, maximum frequency deviation and center-frequency instability. Author

N65-30291 Joint Publications Research Service, Washington, D. C.
STATIC BEHAVIOR OF A TRIGGER UTILIZING TWO TUNNEL DIODES
A. S. Sidorov *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 156–170 refs (See N65-30280 19-09) CFSTI: $6.00

Static behavior of a trigger utilizing two tunnel diodes with inductive memory is analyzed. It is shown that the supply voltage and the current-distribution resistances of the trigger have optimum values determined by the parameters of the tunnel diodes. Input characteristics of the trigger are analyzed. It is noted that the spread of the diffusion branches and of the maximum current of the tunnel diodes materially impairs the current sensitivity of the trigger. Author

N65-30292 Joint Publications Research Service, Washington, D. C.
QUALITATIVE ANALYSIS OF THE TRANSIENT IN A TUNNEL-DIODE FLIP-FLOP
V. I. Vaganov and V. I. Korzh *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 171–183 refs (See N65-30280 19-09) CFSTI: $6.00

A qualitative analysis of a tunnel-diode flip flop with a counter input has been made with positive and negative input signals. The inferences of the qualitative theory have been confirmed by experiment. A method is suggested for improving the quick operation and sensitivity of the flip-flop with the help of a nonlinear load. Author

N65-30293 Joint Publications Research Service, Washington, D. C.
CALCULATION OF THE PARAMETERS OF AN INHOMOGENEOUS SEMICONDUCTOR RC CIRCUIT
M. F. Ponomarev and V. P. Popov *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 184–193 refs (See N65-30280 19-09) CFSTI: $6.00

An analysis of an inhomogeneous semiconductor RC circuit has been made for the case of a small sinusoidal signal at bias voltages considerably smaller than the cutoff voltage of the conducting layer. Expressions have been obtained for four-pole parameters of the circuit in the form of rapidly converging power series. An evaluation of the convergence of the series has been made and recommendations are given on the choice of the number of terms in a series. A comparison of the parameters of a homogeneous and inhomogeneous RC circuit is given. Some network applications of the inhomogeneous RC circuits are examined. Author

N65-30294 Joint Publications Research Service, Washington, D. C.
A GRAPHICO-ANALYTICAL METHOD OF DESIGNING FIELD-EFFECT TRANSISTORS
L. A. Zubritskiy *In its* Izv. VUZov: Radio Engineering, Vol. VIII, No. 2, 1965 6 Aug. 1965 p 194–213 refs (See N65-30280 19-09) CFSTI: $6.00

A method of designing field-effect transistors with an arbitrary geometrical form is examined. The replacement of mathematical expression for the boundary of the space charge and conducting portion of the channel by a graphic construction and the solution of the problem by the method of successive approximations make it possible to design complex structures of the field-effect transistors with comparatively simple means with account taken of various effects occurring in separate sections of the channel and in the semiconductor regions adjacent to it. Author

N65-30295# Siliconix, Inc., Sunnyvale, Calif.
TRANSISTOR, FIELD EFFECT, INSULATED GATE, 100 Mc AMPLIFIER First Quarterly Progress Report, 1 Dec. 1964–1 Mar. 1965
Gerald L. Parker [1965] 24 p ref
(Contract DA-28-043-AMC-00436(E))
(Rept.-1, AD-617424)

Design, manufacture, and evaluation of two study devices, the MOS I and MOS II insulated-gate field-effect transistors, have been completed. Effect of masking tolerances and high-frequency properties have been evaluated; data on d-c and a-c characteristics are recorded and compared to theory. It was found that the major limitations to device performance was the gate-source distributive resistance that charges the gate-source capacitance. A series resistance of approximately 15 ohms transforms into a parallel resistance of 17K at 100 mc. This reduces the real part of the input impedance to 6K typical. This problem will be solved by redesigning the gate bonding pad and shortening the gate length in MOS III to meet the required 20 db power gain for a 100 mc amplifier. Author

N65-30299# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
CROSSED FIELD MICROWAVE TIME DELAY TUBE FEASIBILITY STUDY Final Report, 20 Jul. 1964–20 Jan. 1965
A. Downing and J. I. Smith Griffiss AFB, N.Y., RADC, May 1965 42 p refs
(Contract AF 30(602)-3508)
(PT-900; RADC-TR-65-75; AD-617694)

A program of theoretical and experimental investigation to determine the feasibility of developing a crossed-field microwave tube to operate as a variable time delay device was carried out. During the program, a broadband delay coupler was constructed and tested to determine the limits on bandwidth, insertion loss and signal power level. A large bandwidth fast cyclotron wave synchronous condition was obtained, but with a pronounced reduction in coupling because of the high interception current on the delay circuit. Low coupling made it impossible to obtain accurate data concerning beam saturation levels or insertion loss in the experimental coupler. A computer study of the beam optics in a variable drift space region determined the optimum design for the drift electrode shapes and potential profile for a delay variation of at least 150 nanoseconds. Author

N65-30300# Rome Air Development Center, Griffiss AFB, N. Y.
PHYSICS OF FAILURE IN ELECTRONICS, VOLUME 3
Morton F. Goldberg (IIT Res. Inst.) and Joseph Vaccaro, ed. Apr. 1965 493 p refs Proc. of the RADC-IIT Res. Inst. 1964 Symp., Chicago, 29 Sep.–1 Oct. 1964
(AD-617715)

Physics of Failure in Electronics Symposium papers on test, analysis, and correlation; surface effects; principles and applications; effects in films; and bulk effects are presented. For individual titles see N65-30301–N65-30329.

N65-30301 Autonetics, Anaheim, Calif. WS-133B Components Project Office.
COMPONENT QUALITY ASSURANCE PROGRAMS FOR MICROMINIATURE ELECTRONIC COMPONENTS FOR MINUTEMAN II
Arnold J. Borofsky *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 1–14 refs (See N65-30300 19-09)

Microminiature electronic component suppliers are currently engaged in component quality assurance programs. These programs are designed and are being conducted to assure the timely achievement of Minuteman II Guidance and Control System reliability requirements. This report describes the organization, implementation, and progress to date. Author

N65-30302 Honeywell, Inc., Minneapolis, Minn.
EVALUATION OF R-F NOISE MEASUREMENTS FOR DIODE RELIABILITY IMPROVEMENT BY THE ELIMINATION OF WEAK UNITS
L. Kirvida and C. Maronde *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 15–29 refs (See N65-30300 19-09)

A study of the noise characteristics of a general purpose silicon diode (type 1N645) was made to determine whether excessive r-f noise is correlated with high failure rates. The selection of the abnormally high noise diodes was made by monitoring the noise level across the diode as it was excited with an a-c voltage within the diode maximum ratings. Mechanical stress in the form of impacts within the rated value was applied simultaneously to aggravate structural imperfections. Noise measurements at 25 mc were used for the recognition of

weaknesses and early failure. The forward and reverse characteristics were obtained for the diodes exhibiting high r-f noise. These were compared with the characteristics of diodes exhibiting normal r-f noise. In the forward direction, no difference was obtained; in the reverse biased condition, the average leakage current of all the noisy diodes was considerably higher than the average of the quiet group. In addition it was noted that the r-f noise level of the diodes was almost inversely proportional to the avalanche breakdown voltage. Author

N65-30303 Bell Telephone Labs., Inc., Laureldale, Pa.
APPLICATION OF POWER STEP STRESS TECHNIQUES TO TRANSISTOR LIFE PREDICTIONS
G. C. Sikora and L. E. Miller *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 30–42 refs (See N65-30300 19-09)

This paper describes the use of an n-p-n diffused silicon mesa transistor as a vehicle in an investigation designed to explore the validity of the power step stress technique as a means of predicting life expectancy. Two-hour power step stress was used at various combinations of current and voltage and the devices were stressed to a statistically significant failure level. Carefully determined equivalent junction temperature measurements at various bias voltages were then utilized to correlate this failure to temperature. Data is presented to show that the two major failure modes found in this transistor, namely "collector channeling" and emitter softening are dependent upon bias conditions. It is also shown that junction temperature is not uniquely determined by the absolute power level but is more dependent on the mode of operation. A unique method of plotting power aging data is introduced to demonstrate that device life is primarily determined by junction temperature. This method which employs the current-voltage coordinates of power illustrates that different current-voltage conditions promote different failure mechanisms. Author

N65-30304 Bell Telephone Labs., Inc., Laureldale, Pa.
EMITTER SOFTENING IN DIFFUSED SILICON TRANSISTORS
S. M. Henning and L. E. Miller *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 43–60 refs (See N65-30300 19-09)

This paper summarizes the results of an investigation to determine the mechanism of emitter softening and possible solutions. Detailed examination of the voltage-current characteristics of the emitter diode before and after failure show that the reverse characteristic of the diode changes from a predominantly avalanche mode of breakdown to one which exhibits the characteristics of field emission or tunneling. The presence of field emission suggests that the depletion layer is being modified to the extent that localized areas have very high electric field intensities. An investigation of the cause of the field emission indicated that emitter softening is caused by the diffusion of residual metal impurities into the emitter. Such diffusion occurs most rapidly in areas of localized high temperatures. This explains why softening is found to occur at regions of high current concentration, since more heat is generated in the portion of the collector junction adjacent. Author

N65-30305 General Electric Co., Philadelphia, Pa. Spacecraft Dept.
THE DETERMINATION AND ANALYSIS OF AGING MECHANISMS IN ACCELERATED TESTING OF SELECTED SEMICONDUCTORS, CAPACITORS AND RESISTORS
G. E. Best, G. R. Bretts, H. T. Mc Lean, and H. M. Lampert *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 61–80 refs (See N65-30300 19-09)

This paper will discuss the progress made in applying physics of failure data, experiments and concepts to establishing accelerated test conditions and to evaluating the acceleration factor to be applied in relating the results to some standard test condition. The parts to be discussed are examples of high volume production, high volume usage and consist of a lead-alumino-silicate glass capacitor, silicon passivated planar transistors, silicon alloy-junction diodes and film resistors. Author

N65-30306 Rome Air Development Center, Griffiss AFB, N. Y.
SILICON SURFACE LEAKAGE
Donald J. Nicholson *In its* Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 81–92 (See N65-30300 19-09)

The nature and current theory of reverse current leakage in silicon junctions and its dependence upon surface conditions and gaseous ambients are discussed. Results of preliminary experimental studies of the rate at which reverse leakage changes as a function of the nature and pressure of gaseous ambients are presented. Two distinct modes of behavior are observed: (1) for uptake of gas by the surface, both oxygen and water vapor produce an exponential dependence of reverse leakage on time; (2) for removal of the adsorbed species, the leakage shows a power law dependence of reverse leakage on time. This behavior is clearly identified on growth and decay of a surface channel, both being reaction limited. A result which appears anomalous is the dependence of the rate of leakage decay on the initial value of leakage, and the possible implications of this behavior are developed. Author

N65-30307 Sprague Electric Co., North Adams, Mass. Engineering Labs.
THE CHEMISTRY OF FAILURE OF ALUMINUM ELECTROLYTIC CAPACITORS
Robert S. Alwitt and Reginald G. Hills *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 93–107 refs (See N65-30300 19-09)

Some of the most common failure modes of low voltage aluminum electrolytic capacitors are the result of slow chemical and electrochemical reactions on the electrode surfaces. These reactions are an inherent property of the $Al/Al_2O_3/$ electrolyte system. In this paper the relationship between particular failure modes and these electrode reactions is demonstrated and a detailed description of these reactions is provided. Analysis of 5V and 10V capacitors that failed because of excessive changes in capacitance, dissipation factor or leakage current on test showed that in many cases at least one of the following phenomena had taken place: (1) increase in anode foil capacitance accompanied by decreased ability to withstand voltage stress; (2) increase in cathode foil capacitance; (3) production of gas, probably hydrogen. In all cases the capacitor contained a glycol-borate electrolyte. Author

N65-30308 Philco Corp., Lansdale, Pa.
FAILURE MECHANISMS IN REVERSE-BIASED OXIDE PASSIVATED SILICON DIODES
G. L. Schnable, E. S. Schlegel, and R. S. Keen *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 108–121 refs (See N65-30300 19-09)
(Contract NObsr-89508)

The degradation rate of large area silicon planar diodes under reverse bias in high temperature or gamma radiation ambients has been improved by several process and structural

changes. Data is presented that supports the hypothesis that the degradation mechanism is ion migration. Structural changes designed to reduce the electric field strength at the surface yield lower degradation rates. However, one cannot merely reduce the electric field by reducing the impurity density at the surface over the base region because such a high resistivity layer is more sensitive to variation in surface potential. Process changes which minimize the number of local imperfections improve the degradation rate because these imperfections can create local regions of high electric field. Author

N65-30309 General Electric Co., Syracuse, N. Y. Electronics Lab.
FAILURE MECHANISMS AT SURFACES AND INTERFACES
Klaus K. Reinhartz, Virginia A. Russell, David L. Stockman, W. J. van der Grinten, and Warren L. Willis *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 122–141 refs (See N65-30300 19-09)
(Contract AF 30(602)-3085)

Failure mechanisms at surfaces and interfaces in thin film structures have been studied in thin film field effect triodes. These triodes are very suitable for the study of failures at semiconductor-insulator interfaces as the electrical characteristics strongly depend on the state of this interface. The thin film triodes have been subjected to humidity, to elevated temperature, and electrical stress. During the stress tests the failure of the main materials parameters in these devices have been studied as a function of time and stress. The main failure was a change of the threshold or pinch-off voltage in these devices, indicating that the surface potential of the semiconductor changed under stress. The field effect mobility in the semiconductor was rather constant. The capacitance decreased slightly at elevated temperatures and under electrical stress. The rate equation describing the change of the threshold voltage at elevated temperatures could be explained by assuming a desorption process. Experimentally it could be shown that water contributes to this effect. Author

N65-30310 Autonetics, Anaheim, Calif.
PLANAR SILICON DEVICE FAILURE MECHANISM STUDIES WITH THE MICROANALYZER ELECTRON PROBE
C. C. Nealey and C. W. Laakso *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 142–171 refs (See N65-30300 19-09)

Application of the Physics of Failure approach to electron microprobe testing enables isolation of failure mechanisms at the surface, subsurface, interface, diffusion regions and junctions of planar silicon devices. Foreign element and material defects have been identified. Static and dynamic operation of circuits under test enables current and voltage distribution analyses through the device crystal. Author

N65-30311 Du Mont (Allen B.) Labs., Inc., Clifton, N. J.
PHYSICS OF FAILURE IN COMMERCIALAND
George H. Ebel *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 173–190 refs (See N65-30300 19-09)

What are the major differences between Military and Commercial reliability? The two outstanding differences noted since reliability programs were instituted on our commercial products are that 1. in the commercial field the emphasis on economic justification is greater, and 2. the spread in quality of components being sold to the same specifications is much greater for the commecial market. This paper will discuss the interrelationship of these two aspects of commercial reliability. The greatest gains have resulted in reduced costs and improved reliability through "physics-of-failure" studies. The major reason for this is the misconception among people charged with the responsibility for selecting the parts used in an equipment that there is no difference between component piece parts that are purchased to the same specification. The goal of the commercial physics-of-failure program is to find the significant difference between parts which satisfy the basic specification, and to determine the optimum component for use in the particular application. Author

N65-30312 Boeing Co., Seattle, Wash. Aero-Space Div.
PHYSICS OF FAILURE PRINCIPLES APPLIED TO A DEVICE DEVELOPMENT PROGRAM
T. C. Weston and J. L. Tomlinson *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 191–199 refs (See N65-30300 19-09)

This paper describes a program to develop a high-ohms-per-square tantalum, thin film resistor. Several techniques of physics of failure were used. Among these was a random balance experiment using an accelerated life test as the measure of device reliability. A physics of failure analysis on failed items resulted in the rejection of several of the materials combinations. As a result, the expected life of the basic device was increased by a factor of over one hundred. Author

N65-30313 Aeronautical Radio, Inc., Washington, D. C.
PREDICTION OF DEVICE RELIABILITY BY MECHANISMS-OF-FAILURE PRINCIPLES
G. E. Ingram *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 200–209 (See N65-30300 19-09)

Construction of novel devices for space-age missions requires a new approach to the assessment of reliability of such devices and their components. The method suggested in this paper describes performance characteristics and failure mechanisms of a device in probabilistic terms. Environmental and stress conditions applicable to the device, and its performance and strength characteristics, are expressed in the form of multidimensional probability distributions. By joint evaluation of these probability distributions, a quantitative estimate of the reliability of the device can be obtained. Author

N65-30314 General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
A RELIABILITY PREDICTOR FOR SEMICONDUCTOR DEVICES
Martin F. Chamow *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 210–237 refs (See N65-30300 19-09)

A prediction method for forecasting the operational longevity of semiconductor devices was postulated and demonstrated. It is based on a concept of measuring and assigning quantitative importance to deviations from ideal or perfect behavior. Two independent groups of NPN silicon junction transistors were used to verify the predictor, one of the groups being that from which the predictor was developed. The predictor gave good results with respect to order of failure prediction. R.N.A.

N65-30315 Texas Instruments, Inc., Dallas.
FAILURE ANALYSIS TECHNIQUES
Wilton Workman *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 238–263 refs (See N65-30300 19-09)

A generalized routine for transistor and integrated microelectronic circuit failure analysis is presented. Principal failure modes and analysis techniques are illustrated by charts. R.N.A.

N65-30318 General Precision, Inc., Little Falls, N. J. Kearfoot Div.

AN INVESTIGATION OF THIN FILM RESISTOR FAILURE

P. C. Smith and M. Genser *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 306–314 (See N65-30300 19-09)

A failure analysis was conducted on the degradation of silicon monoxide coatings on glass substrates containing deposited resistors in thin film circuits. Results show that care must be taken in selecting substrates for thin film circuit fabrication. The choice is especially critical if the resistor stripes are close together or if modest potential differences are applied. If any possibility exists that the silicon monoxide might be contaminated by alkali ions from other sources than the substrate, the circuits should be hermatically sealed to eliminate the traces of water vapor which are necessary for the ionic migration and subsequent degradation. R.N.A.

N65-30321 United Aircraft Corp., Norwalk, Conn. Norden Div.

ANION REACTION FOR FAILURE ANALYSIS OF MICROCIRCUIT COMPONENTS

Edwin A. Corl *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 342–353 (See N65-30300 19-09)

An analytical technique for failure analyses on complex interconnected integrated circuits has been developed by employing the selective reaction of certain chemical components with metal interconnections. This technique has proven to be particularly useful in investigating failure due to the following: a. pinholes in metal-oxide-semiconductor capacitors, b. poor or marginal contact of metal to silicon substrate, c. pinholes or weaknesses in the oxide under metalized areas, and d. microscopic breaks in interconnections. The experimental approach is based on the concept of reacting the interconnection metal with an anion which is attracted to electropositive regions and remains unreacted due to repulsion over electronegative metal regions. Illustrations are presented herein consisting of anion reaction patterns on interconnected circuits showing the usefulness of this technique in the determination of poor or marginal capacitors, contacts and interconnections. Author

N65-30322 Battelle Memorial Inst., Columbus, Ohio.

STUDIES OF IMPURITY PROFILES IN SILICON p-n JUNCTION RECTIFIERS

H. C. Gorton *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 355–364 refs (See N65-30300 19-09)

This paper will treat a detailed study of the net ionized impurity concentration, N_A-N_D, obtained from the capacity-voltage measurements of silicon rectifiers as a function of stress temperature and applied reverse voltage for times in excess 10,000 hours. The variation of the capacity-voltage characteristic with time is attributed to changes in both bulk and surface effects, which may be separately identified. Surface effects are related to the adsorption during stress of a negative charge on the region where the depletion layer of the reverse-biased junction intersects the surface, and the adsorption of a positive charge on the surface of the base region beyond the depletion layer. The concentration of surface charge required to account for the observed change in junction capacity is approximately 6.5×10^{10} cm^{-2}, resulting in an apparent change of N_A-N_D of about 2%. Variations in N_A-N_D with stress time of as much as 20% have been observed. Most of the change has been observed to take place within the first 2000 hours. The variation of N_A-N_D with time has not shown a measurable dependence on stress temperature or voltage. Author

N65-30323 Sylvania Electric Products, Inc., Woburn, Mass

THE ROLE OF COMPOUND FORMATION ON SEMICONDUCTOR DEVICE RELIABILITY

B. Selikson *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 365–377 refs (See N65-30300 19-09)

This paper describes a number of experiments aimed at elucidating the mechanism of this intermetallic compound producing failure mode, including the role of silicon in catalyzing the reaction. The various alternate methods of metalizing and bonding to silicon diodes, transistors, and integrated circuits currently in use or being developed today with an aim toward eliminating the intermetallic compound formation are described and analyzed. Finally, a metalization/wire method is presented which eliminates the intermetallic compound failure mode, which makes for a more reliable device, and which also allows for more extreme step-stress testing, hence, accumulation of more useful and earlier reliability data. Author

N65-30325 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.

FAILURE MECHANISMS IN HIGH POWER FOUR-LAYER DIODES

W. Schroen, J. Beaudouin, and K. Hubner (Centre Elec. Horloger) *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 389–403 refs (See N65-30300 19-09)
(Contracts AF 30(602)-2811; AF 30(602)-2949)

High power four-layer diodes which failed during life tests were investigated in order to determine the reasons for their failure. The studies of the silicon chips have shown that the reliability of the diode can be limited by four failure mechanisms: nonuniform turn-on, hot spot development, thermal fatigue, and surface breakdown. Diode burn-out which occurs after the first few pulses at high current gives evidence of nonuniform turn-on of the diode resulting in local heating during a single pulse. The local heat can reach temperatures at which silicon and contact metal alloy further, finally short-circuiting the device. When the damage of the diode by local melting of the silicon metal alloy occurs after many pulses (of the order of 10^3 or more) at appropriate repetition rates it indicates the slow build-up of a hot spot and a subsequent burn-out. These hot spots are formed by lateral thermal instability. Two diode modifications were investigated with respect to hot spot build-up. Another failure mode shows a gradual deterioration of the device characteristics until the center junction is finally short-circuited without melting the silicon metal alloy. Author

N65-30326 Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.

RETARDATION OF DOPANT DIFFUSION DURING FABRICATION AND EFFECTS UPON JUNCTION DEPTH AND MICROELECTRONIC DEVICE PERFORMANCE

E. R. Pemsel, W. J. Lytle, J. W. Dzimianski, and S. M. Skinner *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 404–420 refs Sponsored by RADC (See N65-30300 19-09)

The effects of thin oxide layers on the depth of dopant diffusion and performance in complex microelectronic blocks are investigated. Results show that small thicknesses of silicon oxide produce a measurable effect on dopant penetration into the silicon substrate during emitter-type diffusion. If oxide remains in windows in photoetching masks, the junction depth and breakdown voltage are affected. However, the concentration gradient of the junction under a thin layer of oxide is less sharp than under no oxide and therefore somewhat higher reverse breakdown voltages can be obtained with such junctions. Junction depth for shallow emitter-type diffusions is not greatly affected by substrate resistivity. Investigation of failures in microelectronic devices show that most are caused by faults in the diffusion stage of fabrication. R.N.A.

N65-30327 Bell Telephone Labs., Inc., Allentown, Pa.
SOME FAILURE MODES OF DOUBLE DIFFUSED SILICON MESA TRANSISTORS
A. A. Bergh *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 421–432 refs (See N65-30300 19-09)

This paper discusses two different failure modes (bulk failure and surface failure) which have been observed on double diffused silicon n-p-n mesa transistors. (a) In the presence of bare copper in an oxygen free ambient, power aging degrades the emitter parameters and gain. Only partial recovery can be achieved by etching into the bulk silicon or by heating the device at 300° C (bulk failure). (b) In gold plated and/or oxygen backfilled cans, soft, loopy reverse junction characteristics develop under both temperature and power agings, first on the collector and later on the emitter. Both junctions recover completely upon opening the can and drying the transistor surface (surface failure). Qualitative explanations are offered for both failure modes. Surface failure is due to surface states introduced by the adsorbed water and/or ionic conduction. In order the explain bulk failure, the solubility and precipitation of copper is examined over the transistor profile and the effect of field on the migration of copper in silicon is taken into account. Author

N65-30330# Radio Corp. of America, Camden, N. J. Communications Systems Div.
MICROELEMENT INDUCTORS. TASK 30: MICROMODULE PROGRAM EXTENSION II. PRODUCTION ENGINEERING MEASURE Formal Engineering Report
Jan. 1965 321 p
(Contract DA-36-039-SC-75968)
(AD-610628)

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3. PRODUCTION ENGINEERING MEASURE: MEDIUM FREQUENCY, FIXED INDUCTOR MICROELEMENT 43 p (See N65-30333 19-09)
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N65-30331 United Transformer Co., New York.
PRODUCTION ENGINEERING MEASURE: AUDIO FREQUENCY INDUCTOR MICROMODULE, TASK 30-1 Final Report
In RCA Microelement Inductors Jan. 1965 12 p (See N65-30330 19-09)

A commercially-available audio inductor was found to be suitable for adaptation as a micromodule for military electronic applications. Eighteen individual units were subjected to 2184 hours of electronics tests at 85° C with a 100 mw, 400 cycle loading, and no failures or degradation of characteristics were observed. The test data are included in this report. Present production capacity, exceeding 10000 units per month, is considered satisfactory. J.M.D.

N65-30332 DeLevan Electronics Corp., Aurora, N. Y.
PRODUCTION ENGINEERING MEASURE: LOW FREQUENCY INDUCTOR, TASK 30-2 Final Report
In RCA Microelement Inductors Jan. 1965 26 p (See N65-30330 19-09)

An adjustable micromodule inductor was developed for operation with frequencies between 30 and 200 kc for military electronics applications. It was required that the inductances in this frequency range be between 5 and 100 mh, with a Q value higher than 30 at 100 mh and 75 at 5 mh. The size was not to exceed 0.365 $in.^2$ with height no greater than 0.530 in. Lead terminations on 0.075 in. grid was specified and an access hole at the bottom of the module for tuning through a printed circuit board was required. In addition, the unit was to have no appreciable external magnetic field. Two sets of range samples covering the specified frequencies were fabricated and tested, and the results show that the above goals were met. J.M.D.

N65-30333 Collins Radio Co., Newport Beach, Calif. Components Div.
PRODUCTION ENGINEERING MEASURE: MEDIUM FREQUENCY, FIXED INDUCTOR MICROELEMENT, TASK 30-3 Final Report
In RCA Microelement Inductors Jan. 1965 43 p (See N65-30330 19-09)

A microelement inductor line for use in communication circuits, with frequencies in the range 200 to 1500 kc, was requested in the interest of military electronics applications. Various forms of contained-field magnetic circuits were investigated, and the pot core was chosen as the form most likely to give best performance over the desired inductance range of 2 to 10 mh. Sample units were made of commercial ferrites and were tested over the frequency range at temperatures from −55 to +85° C. The final design is an internally gapped, temperature stable pot core inductor of less than half the diameter of the smallest previously catalogued pot cores, which was found to be useful as a fixed-tuned radio frequency transformer at a fixed amplifier frequency of 455 kc. J.M.D.

N65-30334 TRW Electronics, Des Plaines, Ill.
PRODUCTION ENGINEERING MEASURE: VARIABLE INDUCTOR MICROELEMENT, TASK 30-4 Final Report
In RCA Microelement Inductors Jan. 1965 41 p (See N65-30330 19-09)

A microelement trimmer inductor for use in micromodule intermediate and radio frequency amplifiers operating in the frequency range from 400 kc to 4.5 mc was requested for military electronics applications. The mechanical design of the microelement was to allow adjustment of the inductor after assembly in the micromodule. Using powdered iron or ferrite magnetic materials, microelement inductors were developed which cover a

wide range of circuit applications and performance capabilities. Test results are included which show that the units met the basic requirements. J.M.D.

N65-30335 Collins Radio Co., Newport Beach, Calif. Components Div.
PRODUCTION ENGINEERING MEASURE: HIGH-FREQUENCY, FIXED INDUCTOR MICROELEMENT, TASK 30-5 Final Report
In RCA Microelement Inductors Jan. 1965 37 p (See N65-30330 19-09)

Microelement inductors for military electronics applications in the frequency range of 1.5 to 50 mc with inductances of 0.5 to 100 microhenry were investigated. Unloaded Q-value in the order of 100, and a maximum linear temperature coefficient of about 75 parts per million per centigrade degree over the range −55 to +85° C were also required of the inductors. Numerous basic core and coil designs were considered, and the toroid was selected as having the widest design range of frequency-inductance operating levels at which useful performance could be achieved. Specialized winding methods were devised for the low turn high frequency units. Range samples were wound which demonstrated 1 microhenry core and coil performance at 50 mc; another series produced 100 microhenry at 1.5 mc. J.M.D.

N65-30336 Cambridge Thermionic Corp., Mass.
PRODUCTION ENGINEERING MEASURE: HF AND VHF INDUCTOR MICROELEMENT, TASK 30-6 Final Report
In RCA Microelement Inductors Jan. 1965 47 p (See N65-30330 19-09)

Inductors for military electronics applications with frequencies in the range 50 to 150 mc and inductances from 0.1 and to 1.0 microhenry were requested for mass production. Various experimental magnetic circuit types were considered, and an open toroid (D-core) was found to cover a greater part of the design range and to have greater repeatability than any other basic magnetic circuit. A machine was designed to wind magnet wire on the curved portion of the D-core, which produces a solenoid coil with the captive field and repeat characteristics of the toroid. Using standard powdered iron materials and a glass–mica microelement substrate, inductors were fabricated which meet the specifications; after assembly into test modules the inductors performed successfully in environmental and life tests. The inductors are available on a production basis. J.M.D.

N65-30337 Aladdin Electronics, Nashville, Tenn.
PRODUCTION ENGINEERING MEASURE: MICROMODULE PULSE TRANSFORMER, TASK 30-7 Final Report
In RCA Microelement Inductors Jan. 1965 15 p (See N65-30330 19-09)

The redesigning of microelement pulse transformers into the micromodular form is described. The reliability parameters such as droop, rise time and fall time (in μsec), backswing, overshoot, and output (in volts) were measured. Microelements were subjected to environmental and life tests, and these data support the reliability of the basic design. In small quantities, the cost of a micromodule pulse transformer is high but volume production reduces the cost. W.M.R.

N65-30338 Aladdin Electronics, Nashville, Tenn.
PRODUCTION ENGINEERING MEASURE: PULSE TRANSFORMER MICROELEMENT, TASK 30-8 Final Report
In RCA Microelement Inductors Jan. 1965 37 p (See N65-30330 19-09)

Miniature transformer products were redesigned into the micromodule form factor. Some of the areas considered for the design were: a core material with a low temperature coefficient; permeability; wire size and insulation; microelement wafer geometry; and vendor source. Core structure (core material was coated with glyptol and wound with heavy polyurethane wire as it was mildly conductive); wires (stripped and tinned to proper length, then soldered to proper terminations using a microscope and temperature control); and solder joints and tinning (examined under a microscope to insure proper placement) were the problem areas solved by manufacturing techniques. W.M.R.

N65-30339 TRW Electronics, Des Plaines, Ill.
PRODUCTION ENGINEERING MEASURE: HIGH FREQUENCY TRIMMER INDUCTOR MICROELEMENT, TASK 30-9 Final Report
In RCA Microelement Inductors Jan. 1965 19 p (See N65-30330 19-09)

In improving inductor performances and processes, microelement inductors were produced to demonstrate useful inductor parameters at 15 megacycles. An inductor was developed with a nominal inductance of 2.4 microhenries and a Q factor of 68 as measured at 15 megacycles, and a Q factor of almost 100 when measured at 7.9 megacycles. Basic magnetic circuit, component physical specifications, winding techniques, shield, and substrate were developed. W.M.R.

N65-30340 United Transformer Co., New York.
PRODUCTION ENGINEERING MEASURE: AUDIO TRANSFORMER MICROELEMENT, TASK 30-11 Final Report
In RCA Microelement Inductors Jan. 1965 11 p (See N65-30330 19-09)

A terminating wafer compatible with the micromodule program requirements was designed. The necessary processing to mount the inductor on the micromodule was developed. This mounting was accomplished by using the transformer leads as a method of support. Data on environmental testing are tabulated. W.M.R.

N65-30341 Radio Corp. of America, Somerville, N. J. Semiconductor and Materials Div.
PRODUCTION ENGINEERING MEASURE: INDUCTOR MICROELEMENT MECHANICAL DESIGN REFINEMENT, TASK 30-22 Final Report
In RCA Microelement Inductors Jan. 1965 11 p (See N65-30330 19-09)

This report describes the development of a microelement substrate to be used with toroidal inductors on the Micro Module Program. Many microelement structures for protecting and terminating the .25 inch O.D. toroidal core and coil were reviewed at the beginning of the task. Economics narrowed designs to two: a metalized deep cavity substrate and a square epoxy shell to which metal terminals would be attached. The economics of the metal terminals removed the latter from further consideration and development centered on a deep cavity substrate of ceramic or glass–mica. Ceramic manufacturers considered the .25 inch cavity beyond the state of the ceramic art and the "mold to size" feature of glass–mica led to its selection. Author

N65-30465*# Librascope, Inc., Glendale, Calif. Reliability Div.
EVALUATION TEST PERFORMED BY LIBRASCOPE RELIABILITY DEPARTMENT ON TEXAS INSTRUMENT SOLID CIRCUITS, TYPES SN510, SN512, AND SN515, VOLUME I

G. F. Swygard and L. E. Trempe 28 Feb. 1964 125 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-64135; TR-7-0024) CFSTI: HC $4.00/MF $1.00 CSCL 09C

The effects of thermal, life, and mechanical environments on solid integrated circuits were evaluated for the diffused silicon bistable, the diffused silicon NOR or NAND logic, and the diffused silicon exclusive OR networks. These networks were subjected to thermal sterilization at 145° C for three cycles; thermal cycling from 125° C to −55° C for five cycles; humidity; high temperature operating life at 100° C for 2000 hours; high vacuum operating life at 10^{-4} mm of mercury for 500 hours; shock at 300 G's for five impacts in the x, y, and z directions; and vibration at 35 G's peak for three sweep cycles from 30 cps to 3000 cps in the x, y, and z directions. Specifications, test methods, parameters, failure analyses procedures, and results for each test are described. It was concluded that the networks passed the specifications for the environmental tests to which they were subjected. C.T.C.

N65-30525# Texas Instruments, Inc., Dallas.
GALLIUM ARSENIDE MICROWAVE TRANSISTORS Third Interim Engineering Report, 1 Feb.–30 Apr. 1965
Melvin Belasco May 1965 33 p ref
(Contract AF 33(615)-2101)
(TI-08-65-66; AFAL-TR-65; AD-465814)

The sulfur-diffused emitter technology was incorporated into the standard transistor process. The base contact was altered to be fully compatible with this process and to give low-resistance ohmic contacts. The base diffusion cycle was modified to make it more compatible with the sulfur-diffused emitter. The doping concentration in the epitaxial layer and the specification of the etchback operation were changed to ensure optimum performance of the sulfur-diffused emitter. Transistors fabricated by this new process have very uniform characteristics and high h_{FE}, with values above 20 being typical. Planar, double-diffused GaAs transistors with expanded contacts were built. An SiO_2 film was used to mask the magnesium so that planar collector-base junctions could be made. The sulfur-diffused emitter process was used to form the emitter region of these planar transistors. Author

N65-30575# Naval Ordnance Test Station, China Lake, Calif. Weapons Development Dept.
DESIGN TECHNIQUE OF UHF STRIP-LINE FILTERS
Joseph A. Mosko Apr. 1965 27 p refs
(NAVWEPS-8677; NOTS-TP-3731; AD-616995)

This report describes a new technique in UHF strip-transmission-line filter design. The filter consists mainly of parallel-coupled half-wavelength resonators. The design differs from the usual parallel-coupled resonator configuration in that the usual end-coupled resonators have been replaced by their approximate equivalent circuit. The important advantages realized in the design of this type of parallel-coupled resonator filter are higher power rating, and coupling gaps that are less critical because they are much larger. Several of these experimental strip-line filters were constructed to verify configuration usability. Data obtained proved the excellent performance of this type of modified filter. Author

N65-30628# Western Microwave Lab., Inc., Santa Clara, Calif.
FERRITE AND SEMI-CONDUCTOR MICROWAVE DEVICES. DEVELOPMENT OF A FAST SWITCHING, HIGH POWER DIGITAL PHASE-SHIFTER AT X-BAND Final Report
Robert Addington Jun. 1965 81 p refs
(Contract AF 30(602)-3496)
(AD-616554)

In this report, the final results of the development of a four-bit ferrite phase-shifter are presented. A method of designing a fast switching, latchable, ferrite switch of stripline construction is described. This method incorporates several new design techniques which are a direct product of this development program. The final data is presented for a high power, latchable digital phase-shifter and reference is made to the characteristics of its low power counterpart. Author

N65-30636*# General Electric Co., Schenectady, N. Y. Microwave Tube Business Section.
DEVELOPMENT OF HIGH-TEMPERATURE, HIGH-CURRENT, ALKALI-METAL, VAPOR-FILLED CERAMIC THYRATRONS AND RECTIFIERS Quarterly Progress Report No. 4
A. W. Coolidge 2 Jul. 1965 19 p refs
(Contract NAS3-6005)
(NASA-CR-54448) CFSTI: HC $1.00/MF $0.50 CSCL 09A

A feasibility tube utilizing a thoriated-tungsten cathode was evaluated with respect to inverse emission. A thyratron design with thoriated-tungsten cathode capable of 7 to 15 amperes average is described. Further attempts at evaluating thallium as a vapor fill are described. Some design details of the test vehicles are given. Author

N65-30656# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
CRYOGENIC RADIO-FREQUENCY TUNER Final Report, 1 Jul. 1963–31 Dec. 1964
F. R. Arams, K. Siegel, J. Fradkin, and E. W. Sard Fort Monmouth, N. J., Army Electronics Res. and Develop. Lab. [1964] 61 p refs
(Contract DA-36-039-AMC-03321(E))
(Rept.-3496-1; AD-617128)

This is the final report on a theoretical and experimental investigation of superconducting and other cryogenically cooled circuits for the development of a cryogenic radio-frequency tuner for experimental use with the R390A/URR Radio Receiver. As a result of this investigation, a superconducting RF tuner was successfully developed, and a packaged model suitable for experimental use was demonstrated. This unit has (1) a 3.3-to-1 tuning range of 6.3 to 21 Mc, (2) unloaded Q's ranging from 350 000 to 600 000 over the tuning band, (3) bandwidths adjustable from less than 400 cps to greater than 16 kc, (4) calibrated external controls for main-frequency tuning, fine-frequency tuning and bandwidth, and (5) good resettability. An optimum circuit design was developed to obtain minimum bandwidth variation with frequency consistent with minimizing resonant-frequency variation with bandwidth changes. Split-stator tuning capacitors were used to eliminate superconducting contact problems. The report describes the design considerations and initial superconducting circuit experiments which yielded unloaded Q's as high as 2.2 million near 20 Mc at 4.2° K, and the packaged cryogenic RF tuner itself (including test data). Author

N65-30740# National Semiconductor Corp., Danbury, Conn.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND INCREASE THE RELIABILITY OF THE 2N328A TRANSISTOR Final Report, 30 Jun. 1963–31 Dec. 1964
R. R. Rau and R. Di Paola [1964] 245 p
(Contract DA-36-039-AMC-01480(E))
(AD-614823)

A summary is given of the work performed for improving the reliability of the PNP Silicon Alloy Transistor Type 2N328A. The following processes were modified during the course of the contract: An etch wheel was introduced to more accurately control final device etching; Additional bake-out furnaces were introduced and evaluated to increase the amount of time which the units are heated after etching; A gas recirculator was introduced into the final dry line to reduce the water vapor concentration; Welding shields were introduced at two welding operations while one other process was modified; all these changes were made in order to decrease the amount of weld splash striking the active region of the transistor. Devices produced for the first month of operation of the improved manufacturing line were used for the long term reliability testing. Measurements on devices made during this period of manufacture are included. This reliability evaluation consisted of operational tests for a 1000 hours at power levels of 400, 450, and 500 milliwatts. A specification for an improved 2N328A type transistor incorporating some of the results of evaluations made during this contract is included. Author

N65-30770# Biley Electric Co., Erie, Pa.
MINIATURE CRYSTAL UNITS FOR SINGLE-SIDEBAND OPERATIONS Quarterly Report, 1 Dec. 1964–28 Feb. 1965
J. M. Wolfskill, Roy Spurlin, and Robert Mouck [1965] 22 p
Contract DA-28-043-AMC-00148(E))
(QR-3; AD-617110)

This project requires the development and fabrication of special crystal units designed especially for use in portable single-sideband communications equipment. The crystals, in the 5- to 20-megacycle range, are mounted in miniature HC-26 glass holders. Operated at 10-microwatts drive, these crystals must attain 200,000 Q and have matched temperature characteristics. This report reviews the third quarterly interval of the project: fabrication and testing of the first developmental model samples were undertaken. Serious problems were encountered in producing these units; losses in sealing were much more severe than had been expected. Most of the losses were because of distortion of temperature characteristics as a result of sealing. These distortions resulted from twinning of small portions of the quartz resonators—a condition which was often not accompanied by significant changes in resistance values. Although not completed during the period covered by this report, changes in sealing fixtures and techniques promise to minimize this problem on future groups. Author

N65-30779# Sperry Microwave Electronics Co., Clearwater, Fla.
MICROWAVE FERROELECTRIC PHASE SHIFTERS AND SWITCHES Final Report, 15 Jun. 1963–15 Mar. 1965
L. J. Lavedan and M. R. Donaldson Mar. 1965 112 p refs
(Contract DA-36-039-AMC-02340(E))
(SJ-230-0046-5; AD-616754)

Final data are given for UHF, L, and S band ferroelectric phase shifters and switches. The best ferroelectric material developed was ($Pb_{0.315}Sr_{0.685}TiO_3$) which has the following properties: $0.05 < TAN\ \delta < 0.06$ and $0.6 < \Delta C_F/C_F < 0.7$. This material used in stripline structures resulted in UHF and L band phase shifters nominally with 0° to 200° relative phase shift and 1 to 3 db insertion loss over a 10% band. S band devices exhibit 0° to 200° relative phase shift with 1 to 5 db insertion loss. The same material used in multistub ferroelectric switches resulted in an L band three-stub switch with 40 db isolation and less than 1 db insertion loss over a 10% bandwidth. Two- and three-stub UHF band devices are believed to be capable of yielding similar results. S band devices are believed to be capable of giving 30 db isolation with less than 1 db insertion loss over a 10% bandwidth. New ferroelectric materials with loss factors less than 0.04 and change in capacitance $\Delta C_F/C_F > 0.75$ will lead to phase shifters and switches with significantly improved properties. Details and results of a computer analysis of the multistub switch are given. Author

N65-30785# Bell Telephone Labs., Inc., New York
MICROWAVE DIODE RESEARCH Eleventh Quarterly Progress Report, 10 Dec. 1964–9 Mar. 1965
B. C. De Loach, R. L. Johnston, and R. C. Swenson 20 Jun. 1965 31 p refs
(Contract DA-36-039-SC-89205)
(Rept.-20; AD-616752)

Measurement of the loss and reactance for characterizing microwave diodes is described in Chapter 1. Corrections are given for the tuning-stub transmission loss method, in which the basic scheme is to measure the loss introduced when the diode is series-tuned to shunt with a transmission line. The tuning stub has to be calibrated for both loss and reactance since the former is not a constant as has sometimes been assumed. The method has been used primarily at 1 Gc. In Chapter 2 are described preliminary measurements on an exploratory oscillator. Although not part of the contract, this work is reported because it is related to the contract objectives. Continuous-wave oscillations have been obtained from a reverse-biased silicon diode. An output of approximately 3 mw at 8.9 Gc was obtained at 0.1 percent efficiency. The oscillator also sometimes gave self-pumped parametric oscillations, which at first were inexplicable but now have been identified. Author

N65-30794# Hughes Aircraft Co., Los Angeles, Calif. Microwave Tube Div.
APPLIED RESEARCH ON EFFICIENCY IMPROVEMENT IN O-TYPE TRAVELING-WAVE TUBES Interim Engineering Report, 15 Jan.–15 Apr. 1965
O. Sauseng Apr. 1965 79 p refs
(Contract AF 33(615)-1951)
(IER-3; AD-616736)

A single voltage jump taper has been tested in the demountable apparatus. The preliminary results show that substantial efficiency improvements are possible with this method. Electronic efficiencies up to 43%, and depressed efficiencies up to 56% have been observed. At the best overall efficiency the electronic efficiency is improved by 30% (factor 1.3) and the depressed collector efficiency by 20% (factor 1.2) as compared with the highest efficiencies which could be obtained with the standard circuit alone. The circuit parameters were reevaluated with the electron beam and a significant change of the "hot circuit" parameters from those of the cold circuit was observed. The "hot" phase velocities were found to be about 10 to 15% higher, while the "hot" coupling impedance was about 10 to 20% lower than the cold circuit parameters, practically independent of the frequency. Corrected tube parameters based on the "hot circuit" parameters are given. The design of velocity step tapers for coupled cavity circuits is outlined in detail. Author

N65-30796# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
FREQUENCY MULTIPLIER Quarterly Report, 1 Dec. 1964–28 Feb. 1965
G. P. Kurpis and J. J. Taub [1965] 31 p refs
(Contract DA-28-043-AMC-00438(E))
(QR-1; AD-616635)

The component arrangements suitable for developing a solid-state multiplier chain that has an output power of 20 microwatts at 100 Gc has been studied. The most suitable arrangement uses a 20.833-Mc crystal-controlled transistor

oscillator multiplied and amplified to deliver 4 watts at 104.166 Mc. This is then multiplied by 80 by means of step-recovery diode circuits. The remaining multiplication by 12 is accomplished with varactors using one tripler and two doublers. The design approach to be used for each of the varactor and step-recovery diode circuits concludes the report. Author

N65-30798# Army Electronics Labs., Fort Monmouth, N. J. Solid State and Frequency Control Div.

MICROWAVE AMPLIFIER PERFORMANCE OF GERMANIUM TRANSISTORS

G. E. Hambleton and V. Gelnovatch Apr. 1965 68 p refs
(ECOM-2579; AD-616772)

This report describes an investigation of available microwave transistors in a standard, single-stage amplifier configuration at L-band. The program consisted of the measurement of a total of 70 transistors from Bell Telephone Laboratories and Texas Instruments for noise and power gain properties at two frequencies near 1.0 Gc. The measurement conditions consisted of two emitter current levels, 2 and 5 milliamperes, and combinations of impedance matching on the input and output ports. Standard coaxial r-f components were used, with isolators at the input and output ports of the amplifier to establish an exact 50 ohm reference. Y-parameters were also measured on the BTL transistors. The y-parameters were used to calculate quality factors such as unilateral gain, maximum stable gain, and maximum available gain. Noise figure was calculated for an average of the y-parameters as a function of frequency and source resistance. The measured gains and noise figures were compared to calculated values and correlation data is presented. Author

N65-30810# Army Missile Command, Huntsville, Ala. Electromagnetics Lab.

DESIGN CONSIDERATIONS FOR TRANSMISSION LINES AND PULSE-FORMING NETWORKS

Ralph W. Hawkins 29 Sep. 1964 23 p
(RE-TM-64-7; AD-615824)

The lumped-constant analysis of transmission lines is given. Transient voltages and currents in infinite, open circuit, and terminated transmission lines are considered. The use of a transmission line as a pulse generator is discussed. The optimum operating point for xenon flashlamps is studied. Transmission line energy is calculated. TAB

N65-30816# Advanced Technology Corp., Timonium, Md.

DIODE, MILLIMETER-WAVE TYPE MIXER (3.2 MM) Sixth Quarterly Progress Report, 1 Sep.–30 Nov. 1964

R. J. Bauer and J. W. Dozier 31 Dec. 1964 31 p refs
(Contract DA-36-039-AMC-02347(E))
(AD-615743)

Temperature test results are presented on several sealed point contact diodes. Measurements have also continued on monitoring electrical performance versus diode age. Preliminary tests were conducted to insure that diode burnout would not be a problem. Millimeter wave VSWR measurements are compared between fixed tuned and variable tuned integrated waveguide-diode mounts. The last major problem of the program, that of providing a good IF VSWR, has been resolved. Tunnel diode mixers have been reinvestigated. A family of curves on conversion loss versus forward bias and local oscillator power is presented for one of the tunnel diode mixers. Author

N65-30821# General Electric Co., Philadelphia, Pa. Missile and Space Div.

LIFE TESTS ON CAPACITORS FOR PULSED PLASMA ENGINE APPLICATIONS

Bernard Gorowitz and Thomas W. Karras Jun. 1965 14 p
(R65SD26; AD-616771)

A description is given of tests conducted with some off the shelf energy storage capacitors for the purpose of investigating life, failure modes and weight to power ratios. Up to 6.4×10^7 shots were obtained with a given unit. Suggestions for the improvement of capacitor reliability and weight to power ratio are presented. Author

N65-30822# Laboratory for Electronics, Inc., Boston, Mass. Solid State Electronics Lab.

ELECTRO-OPTICAL MATRIX DISPLAY Final Engineering Report No. 480–A1, 1 May 1964–29 Apr. 1965

Jun. 1965 57 p refs
(Contract NObsr-91199)
(AD-616755)

Phases I and II of the program were completed. Information was obtained concerning the dependence of the dense-banded domain structure on parameters of film preparation in order to be able to produce good display elements with reduced coercive force. The best results were obtained using melt compositions of 83-17 NiFe, high evaporation rates and high substrate temperature. A substantial development effort in preparation of display colloid resulted in a good understanding of the nature of the several processes that can be used. The required control in colloid preparation is possible with a process based upon forming first a seed solution of particles of small and very uniform size, then controlledly enlarging the seed particles, and finally adding the magnetic property. Techniques of panel module assembly were studied, including edge encapsulation, inner bonding and silk screening. Experimental cells were made that show no sign of seal deficiency after five months. Several techniques of addressing display elements were verified. These include pulsed coincident currents, and coincidence of a.c. and pulsed currents for both spot and line-at-a-time writing. A demonstration model was constructed which makes it possible to command a 16 × 16 matrix of display spots on a line-at-a-time basis. TAB

N65-30823# Westinghouse Electric Corp., Washington, D. C.

500 WATT SILICON POWER TRANSISTOR Quarterly Report, 1 Feb.–30 Apr. 1965

[1965] 26 p ref
(Contract NOBsr-91001)
(QR-7; AD-616612)

The electrical characteristics of 500 watt silicon power transistor units are reported and discussed. A working process was developed for collector contacting, and the technique is described. Twelve units were completely encapsulated. Polytetrafluoroethylene type of Teflon was found to meet the requirements for a material which is soft enough to conform to the mesa structure, but still able to support the required load at 200° C. The material is inert, and is a good insulator. L3

N65-30833*# Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.

BRUSHLESS D. C. TORQUE MOTOR Second Quarterly Report, 25 Sep.–25 Dec. 1964

W. W. Yates and R. E. Skamfer [1964] 35 p
(Contract NAS5-3934)
(NASA-CR-64342; WAED-64-73E) CFSTI: HC $2.00/MF $0.50 CSCL 09C

The manufacturing and procurement of components and the preparation of test documents are reported. Also, design

considerations were evaluated. The self-lubricated torque motor bearings were tested. The bearings were equipped with a high-strength self-lubricating composite retainer composed of a sintered silver-mercury amalgam matrix containing homogeneously distributed pockets of Teflon. Screening tests indicated that for maximum mechanical strength both the Teflon and silver powder before amalgamation should consist of equal parts of submicron and coarse particles. The blanks from which the retainer was machined were formed under a combination of heat and pressure into 1 1/2-inch long rings 1 1/2 O.D. by 3/4-inch I. D. The retainers were not shrouded and weighed approximately 20 grams each. E.E.B.

N65-30835*# MetroPhysics, Inc., Santa Barbara, Calif.
DEVELOPMENT OF A SOLID STATE THERMOSTAT Final Report
Fritz J. Malek 10 Mar. 1965 50 p
(Contract NAS8-11625)
(NASA-CR-64311; WA-645201) CFSTI: HC $2.00/MF $0.50
CSCL 14B

A 1 amp solid state thermostat is described, and test results and recommendations for future modifications are presented. All considerations leading to the adopted design are discussed. The thermostat surpasses mechanical types with respect to accuracy and reliability. It provides a temperature output signal which can be used to monitor the temperature under control continuously by automatic checkout equipment or telemetry systems. Its inherent ruggedness and the absence of any moving parts make it ideally suited for space and airborne applications. R.N.A.

N65-30868# Bendix Corp., Davenport, Iowa. Pioneer-Central Div.
FREQUENCY TEMPERATURE COMPENSATION TECHNIQUES FOR QUARTZ CRYSTAL OSCILLATORS Sixth Quarterly Interim Report, 1 Jul. 1963–31 Dec. 1964
Richard H. Bangert and Darrell E. Newell 4 Mar. 1964 84 p refs
(Contract DA-36-039-AMC-02282(E))
(Publ.-3211-65; AD-617164)

The work covered in this report was performed to achieve two major objectives: (1) develop ovenless quartz crystal oscillators having frequency stabilities heretofore obtainable only with oven controlled oscillators over wide temperature ranges; and (2) find methods for standardizing both the oscillator configuration and the methods of obtaining the component values required for compensation. A method of standardizing component value selection by computer methods was tried and, within the limitations of the computer used, proved to be quite successful. The three groups of TXCO's were fabricated and tested and found to meet or approach design goal requirements. Author

N65-30897# Central Lab. for Radiological Protection, Warsaw (Poland). Inst. of Nuclear Research.
MULTI-GARD-RING GOLD-SILICON SURFACE-BARRIER DETECTORS
J. Roman, A. Dabrowski, S. Glowacki, M. Jagusztyn, M. Slapa et al 1965 12 p refs
(CLOR/IBJ-II-36/D)

Gold-silicon surface-barrier beta spectrometers with multi-gard-rings /3000-5000 ohmcm n-type silicon/ have been made. The devices have proved to be very stable in long-term operation and to withstand at room temperature a reverse bias greater than 1500 volts. The reverse-current passing through the signal electrode and the gard-rings was less than 1 uamp at 1000 volts bias. The beta particles and internal-conversion electrons energy spectra have been measured. The energy resolution at room temperature was of about 9 kev/f.w.h.m./ for 625 kev electrons. Author

N65-30918# Radio Corp. of America, Cambridge, Ohio. Communications Systems Div.
MICROMODULE LIFE TEST Quarterly Progress Report, 17 Dec. 1964–17 Mar. 1965
G. E. Cannon [1965] 90 p refs
(Contract DA-36-039-AMC-01462(E))
(QPR-2; AD-616744)

Progress is reported on life testing of micromodules. A total of 2703 micromodules remained on life test at the beginning of this quarter and nine failures occurred during the period. The number of failures, accumulated operating time, and lower 60 percent confidence level mean-time-to-failure (MTTF) for life testing to date are given. TAB

N65-30923*# Oklahoma State Univ., Stillwater. School of Electrical Engineering.
POWER RELAY DESIGN. ANALYZE, STUDY AND ESTABLISH AN OPTIMUM POWER RELAY DESIGN FOR APPLICATION IN SATURN LAUNCH VEHICLE SYSTEMS Summary Report, Jan.–Jul. 1962
C. F. Cameron [1962] 225 p
(Contract WAS8-2552)
(NASA-CR-64298) CFSTI: HC $6.00/MF $1.25

Contactor design, rating, and characteristics and vibration tests were studied to establish optimum power relay design for application in Saturn Launch Vehicle Systems. Transient coil current characteristics for operate and release are shown in oscillograms, and data concerning the vibrational failure of the relays were accumulated to aid in redesign. A theoretical investigation and some experimental data are given for an electrical contact failure caused by electrical loading, and a preliminary contact rating study was conducted. Verification is made of the form of the contactor design equations, the theory of design is applied to relays, and redesign efforts are summarized. M.W.R.

N65-30949# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
RECIPROCAL WAVEGUIDE DEVICES FOR ELECTRONIC POLARIZATION CONTROL
W. J. Wesner 31 May 1965 47 p refs
(Contract NOw-64-0293-d)
(Rept.-1804-4; AD-617124)

A reciprocal waveguide device is proposed to control electronically the polarization angle of a linearly polarized electromagnetic wave at microwave frequencies. Two approaches are discussed and experimental measurements are included to demonstrate successful operation. Reciprocal electronic phase shifters, required for each approach, are surveyed and a ferrite type is discussed in detail. Author

N65-30962# Kansas Univ., Lawrence. Dept of Electrical Engineering.
AN INVESTIGATION OF PULSE DURATION MODULATION
Billy F. Lucas (M.S. Thesis) 1965 54 p refs
(Contract AF 33(608)-1076)
(AD-617085)

This investigation shows that a pulse duration modulation system can be made to work with low distortion. A simple four-section RC filter with a tuned circuit for carrier rejection was used to recover the signal. At the beginning of the investigation

an attempt was made to measure the magnitude of each sideband using a harmonic wave analyzer. This method did not work because different sidebands fall at the same frequency (or within a few cycles) and gave readings very difficult to decipher. A small drift in either frequency (especially the signal multiples of it appear in the sidebands) caused all sidebands to drift. Since lower and upper sidebands drifted in opposite directions with a frequency change two successive readings could disagree drastically. TAB

N65-30969# Centre de Physique Electronique et Corpusculaire, Orsay (France).
GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS Technical Report No. 5, 1 Jul.–31 Dec. 1964
[1964] 42 p
(Contract AT 61(052)-715)
(WR-1360; RADC-TR-65-245; AD-616546)

It is desired to extend the state of the art of O-type carcinotron oscillators to the generation of submillimeter waves down to 0.3 mm. A 0.4 mm. tube was operated satisfactorily in C.W. condition. A few milliwatts were obtained on the band between 682 and 766 Gc/s. The overall design of guns and tubes was improved. High voltage handling can now be obtained over the ten kilovolts range. TAB

N65-31082# Fairchild Semiconductor Corp., Mountain View, Calif.
PRODUCTION ENGINEERING MEASURE FOR IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY FOR PNP INTERMEDIATE POWER SILICON PLANAR SWITCHING TRANSISTORS INCLUDING 2N3502 Quarterly Progress Report, 1 Jan.–31 Mar. 1965
Rodolfo C. Dorilag and John C. Diepeveen [1965] 30 p refs
(Contract DA-36-039-AMC-06155(E))
(QPR-1; AD-617893)

Progress is reported in improving production methods to increase the reliability of PNP intermediate power silicon planar switching transistors including type 2N3502. Developments are presented on the mechanized semiautomatic masking process, improved optical jigs and mask alignment, and improved control of beta distribution. Feasibility tests were conducted and approved on the masking operation. Designing of various mechanical modifications were begun. Design layouts were completed for the microscope, light source, and chuck and positioner assemblies of the optical alignment jig. A survey was made of the 2N3502 devices and indicated that beta variation is most pronounced in the vertical direction of a wafer. It is maximum on top of the wafer and minimum at the bottom. It appears that the secondary doping source and material variation do not contribute to beta variation. R.N.A.

N65-31092# Texas Instruments, Inc., Dallas.
LOW NOISE L-BAND TRANSISTOR Quarterly Progress Report No. 3, 15 Nov. 1964–15 Feb. 1965
Doyle S. Granberry 15 Mar. 1965 26 p refs
(Contract DA-28-043-AMC-00119(E))
(TI-03-65-28; AD-616781)

Technology has improved in areas of device geometry, evaporating impurity materials, and other doping techniques. Although serious questions had been raised about the adequacy of base contacts, these base contacts were studied and found adequate. Measuring techniques using the common emitter connection now indicate that noise figures at 1.3 Gc may be much better than earlier tests showed them to be. Author

N65-31164# Royal Aircraft Establishment, Farnborough (England).
TIMING PULSE GENERATION FOR A SYNCHRONOUS LOGIC SYSTEM
R. Harris London, Min. of Aviation, Dec. 1963 46 p refs
(RAE-TN-IEE-33)

A description is given of three pulse generators which produce related waveforms used in the control of a directly coupled logic system. The directly coupled transistor logic (DCTL) technique is first expounded in so far as it is relevant to the material in the text. Each generator is considered first in general terms complete with the associated logic diagrams, and then a detailed description is given of the practical interpretation illustrated with schematic diagrams and waveforms. Author

N65-31168# Harry Diamond Labs., Washington, D. C.
CIRCUITRY AND OPERATION OF AN X-BAND INTERFEROMETER FOR SHOCK-TUBEM MEASUREMENTS USING THE DIELECTRIC SLAB A APPROXIMATION
J. C. Blackburn and F. L. Tevelow 22 Apr. 1965 46 p refs
(HDL-TR-1275; AD-617117)

The experimental methods and equipment used in analyzing transient shock-generated plasmas by X-band microwave interaction techniques are presented in considerable detail. A transmission technique (for electron densities of 10^{10} to 10^{13} electrons/cm^3) and a reflection technique (extending the range to about 10^{16} electrons/cm^3) are discussed with respect to the construction and adjustment of the microwave apparatus and the required data reduction. An evaluation of the experimental errors due to the electronic equipment and data reduction procedure is given. Author

N65-31197# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DESIGN AND SIMULATION OF SELF-ADAPTIVE OPTIMIZING SYSTEMS
G. Bergholz 25 May 1965 16 p refs Transl. into ENGLISH from Messern-Steuern-Regeln (East Germany), v. 7, no. 3, 1964 p 139–143 Presented at the VIIIth Intern. Colloq. of the Polytech. Inst., Ilmenau, East Germany, 7 Oct. 1963
(FTD-TT-65-137/1+2; AD-467365)

Investigations were conducted on self-adaptive optimizing systems to obtain possibilities for the calculation and design of self-seeking systems. Two variations of the gradient method and the realization with a five channel optimizer are discussed. A number of calculation results are represented for an optimizing system with the objective of having a statistical characteristic curve. R.N.A.

N65-31200# Fairchild Semiconductor Corp., Mountain View, Calif.
X-BAND SOLID-STATE POWER SOURCE Third Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
E. Guthrie, R. Henschke, R. Orrick, and D. Richardson [1964] 51 p refs
(Contract DA-28-043-AMC-00120(E))
(Rept.-3; AD-616738)

A transistor oscillator driver circuit has been constructed that produces 1.25 watts from 1.06 to 1.13 Gc. Another prototype oscillator has been tested and produces 1.0 watt from 1.4 to 1.5 Gc. Test jigs for the corresponding frequency multipliers have been constructed. A couple of silicon varactor diodes have given 40% conversion efficiency in the quadrupler jig going from 1.1 Gc to 4.4 Gc. Also, 60% efficiency was achieved with a gallium arsenide diode in a doubler jig going from 4.4 Gc to 8.8 Gc. The sextupler jig is complete and several diodes are being evaluated. Author

N65-31218# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
A SOLID-STATE MULTIPLEXER FOR USE WITH SELF-POWERED NEUTRON FLUX DETECTORS
K. R. Morin and C. G. Lennox Apr. 1965 31 p refs Presented at the 7th Tripartite Instrumentation Conf. (Reactors), Bournemouth, England, 27 May 1965
(AECL-2217) Available from Atomic Energy of Canada, Chalk River: $1.00

This report describes a 128-input low-current-level, high input impedance solid-state analog multiplexer. This multiplexer was designed and built at AECL to connect the signals from about 80 self-powered neutron flux detectors to the PDP-5 computer at NRU. The multiplexer consists of a double-banked switching arrangement (eight groups of 16 shunt switches, followed by a second bank of eight series switches). The switches are followed by a common amplifier which produces an output of 0.8 volts full scale for a signal input of one microampere. A seven-bit address register determines the selected input. The source impedance can be neglected if greater than 10^8ohms. The overall accuracy of the multiplexer is one percent. Author

N65-31234# ITT Federal Labs., Nutley, N. J.
METHODS AND TECHNIQUES STUDY REPORT, THREE-OSCILLATOR COMBINER
Jun. 1965 190 p
(Contract NObsr-93087)
(TD65-202; AD-617144)

To achieve the high degree of accuracy required in modern communication systems at military sites, a single frequency source for all subsystems seems advisable. Specifically, it is recommended that a single oscillator, backed up by one or more oscillators, be used for reliable frequency control, and that a device be developed for combining the oscillator signals to provide a continuous frequency source, free of momentary interruptions and sudden phase discontinuites. Several analog and digital combiners were investigated, and their advantages and disadvantages are listed. It was found that a master/slave model can be used to obtain a mean-time-between-failure of ten years for simultaneous failure of three channels, and 5000 hours for single failures. All of the models appear adaptable for fault localization and condition checking, and for microminiaturization. J.M.D.

N65-31235# CTS Knights, Inc., Sandwich, Ill.
CRYSTAL UNITS TYPE CR-(XM-II)/U 1 TO 20 MC IN THE TYPE HC-27/U GLASS HOLDERS Step I Completion Report
Roger E. Bennett Mar. 1965 106 p
(Contract DA-36-039-SC-81274)
(AD-617006)

Designs and production processes, together with yields, are given for the XM-11/U (CR-18/U in glass). Aging data is also given. The frequencies covered are 4.3, 9, 15.5, and 20 mc. Data is also given on experimental designs for a 1 mc unit. An induction sealing machine is described. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-30191# Weapons Research Establishment (Australia).
AN EXTENSION OF THE RESULTS OBTAINED BY THE APPLICATION OF THE NUMERICAL SOLUTION OF LAPLACE'S EQUATION TO TRANSMISSION LINE PROBLEMS
H. E. Green Feb. 1965 25 p refs
(WRE-TN-PAD-98)

In this paper a method developed in an earlier paper for the solution of Laplace's equation by finite differences is applied to the problems of determining the equivalent circuit of a series gap in the inner conductor of a coaxial line and of computing characteristic impedance and velocity ratio of microstrip transmission line. An extension to the theory of compensated bead supports in coaxial line is also made. Author

N65-30224# Technical Operations Research, Burlington, Mass.
MODELS OF COMMAND AND CONTROL SYSTEMS, WITH APPLICATIONS TO EXERCISE AND EVALUATION Final Report, 30 Nov. 1963–31 Jan. 1965
Peter Kugel and Martin F. Owens Bedford, Mass., AFSC, Electron. Systems Div. Feb. 1965 146 p refs
(Contract AF 19(628)-2455)
(ESD-TDR-65-183; AD-615549)

Five models of the activities of command and control systems are described to provide a precise, if not necessarily quantitative, framework within which the behavior of command and control systems can be studied. Such models are intended as the basis for theories into which empirical data about this behavior, derived from the observation of exercises, could be fitted to provide predictions about the future behavior of particular systems. Author

N65-30225# Joint Publications Research Service, Washington, D. C.
CYBERNETICS, NO. 2, 1965
20 Jul. 1965 203 p refs Transl. into ENGLISH of Kibernetika (Kiev), no. 2, Mar.–Apr. 1965 104 p
(JPRS-31164; TT-65-31662) CFSTI: $6.00

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16. ON ONE METHOD OF SYNTHESIS OF OPTIMAL AUTOMATIC CONTROL SYSTEMS V. I. Ivanenko and V.S. Korolyuk p 185–192 refs (See N65-30241 19-10)

N65-30228 Joint Publications Research Service, Washington, D. C.

ON ASYMPTOTIC EVALUATIONS OF COMPLEXITY OF SOME RELAY NETWORK CLASSES

A. D. Korshunov *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 34–55 refs (See N65-30225 19-10) CFSTI: $6.00

The function of a relay network with limited topology is analyzed, and the asymptotic behavior of function $L_\psi(n)$-minimal number of relays sufficient for realization of any function of n variables in this case is established. A solution proving the asymptotic behavior of function L(n,k) in the general relay network, where L(n,k) is the minimal number of k paired orthogonal functions of n variables is also presented. G.G.

N65-30229 Joint Publications Research Service, Washington, D. C.

SOME REMARKS ON SIMULATION OF ADAPTATION TO ENVIRONMENT OF FINITE AUTOMATA

Yu. M. Borodyanskiy *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 56–64 (See N65-30225 19-10) CFSTI: $6.00

Simulated adaptation to an environment was studied by two finite, connected automata representing the animal and the environment, where the output signal of one apparatus acts as input for the other apparatus. Considered was the behavior of the animal in a case where it receives the maximum number of favorable signals under a given environment and a given division of the alphabet. The adaptation of the animal to a given environment was analyzed by algorithms for the two partially or totally integrated stages of (1) perception of environment, and (2) adaptation to a known environment. G.G.

N65-30230 Joint Publications Research Service, Washington, D. C.

A REMARK ON THE COMPLEXITY OF PROBABILISTIC AND DETERMINATE AUTOMATA

I. N. Kovalenko *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 65–68 refs (See N65-30225 19-10) CFSTI: $6.00

Randomization was used to minimize the complexity of a discrete apparatus that separates forms by an arbitrarily great number of times. Examined is the case of a finite automaton with an input alphabet {0,1} and a set of possible words at the input $S_n = S_n^0 \cup S_n^1$, where all words S_n have length n, and the words entering into set S_n^0 have not more than n/3 units; words entering into S_n^1 have no less than 2n/3 units. An automaton was constructed by algebraic analysis with a limited number of states that distinguishes events S_n^0 and S_n^1 with a probability exceeding $1 - \epsilon$. G.G.

N65-30232 Joint Publications Research Service, Washington, D. C.

ON ONE THREE-VALUED ALGEBRA CLASS AND ITS APPLICATION TO SYNTHESIS OF TERNARY LOGIC NETWORKS OF TERNARY ELEMENTS

Yu. L. Ivas'kiv *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 86–98 refs (See N65-30225 19-10) CFSTI: $6.00

Canonical forms of describing functions are analyzed for their effectiveness in synthesis of ternary logical networks from stable elements. Discussed is the case where canonical forms are constructed analogous to corresponding disjunctive normal forms of Boolean algebra, while the synthesis of expressions analogous to Boolean constituents is accomplished for each of the described subsets. G.G.

N65-30233 Joint Publications Research Service, Washington, D. C.

MINIMIZATION ALGORITHMS FOR WEAKLY DETERMINED BOOLEAN FUNCTIONS

A. D. Zakrevskiy *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 99–114 refs (See N65-30225 19-10) CFSTI: $6.00

Minimization algorithms of weakly determined functions are used to find minimal or shortest disjunctive normal forms of Boolean functions containing a great number of variables that are defined only on a small part of the Boolean range. An algorithm for obtaining an unempty set of shortest coverings was developed that gives good approximations to minimal coverings. G.G.

N65-30235 Joint Publications Research Service, Washington, D. C.

A METHOD FOR OBTAINING POTENTIALLY ZERO EQUIPOTENTIAL POINTS IN ELECTRONIC MODELS

G. Ye. Pukhov *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 133–135 (See N65-30225 19-10) CFSTI: $6.00

Successive realization of potentially zero and equipotential points in a computer can be realized by substitution of all amplifiers with capable condensers at the outputs. A periodic process was created by successive equilibration of each group of points with its amplifier, and the obtained currents and voltages were similar to those values reached with a parallel method of equilibration. This method can be used to construct reversible and irreversible summators, quasinegative resistances, functional transformers, and a variety of other automata. The circuit for an automatic equilibrium model is shown. G.G.

N65-30240 Joint Publications Research Service, Washington, D. C.

A PROBABILISTIC MODEL FOR A MULTILINEAR SIGNAL COUNTER

A. A. Alekseyev *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 170–184 refs (See N65-30225 19-10) CFSTI: $6.00

The construction of a probabilistic model of a multilinear counter that registers a random current of multicomponent signals was studied by determining the probabilities for the counter states in stationary and nonstationary operation. Examples for a bilinear counter, and for a multilinear counter with a poisson signal current are given, and a formula for the average number of occupied channels at a time for a general case is shown. G.G.

N65-30241 Joint Publications Research Service, Washington, D. C.
ON ONE METHOD OF SYNTHESIS OF OPTIMAL AUTOMATIC CONTROL SYSTEMS
V. I. Ivanenko and V. S. Korolyuk *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 185–192 refs (See N65-30225 19-10) CFSTI: $6.00

A control circuit was determined by synthesis that minimizes the average value of control by considering the work of the control apparatus and the penalty for uncorrected work. Considered were losses in automatic control systems with correct working machines, and also losses in incorrect working machines without control. G.G.

N65-30250# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF CYBERNETICS, NO. 12, 1964
A. A. Lyapunov, ed. 22 Jul. 1965 394 p refs Transl. into ENGLISH of the book "Voprosy Kibernetiki" Moscow, Sci. Publishing House, 1964 p 1–260
(JPRS-31214; TT-65-31711) CFSTI: $7.00

Translation of Russian anthology on cybernetics covering the theory of control systems; information theory and coding; programming; mathematical economics; and control processes in living organisms is presented. For individual titles see N65-30251–N65-30270.

N65-30251 Joint Publications Research Service, Washington, D. C.
EQUIVALENT TRANSFORMATIONS OF CERTAIN TYPES OF AUTOMATA
N. A. Gorbovitskaya *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 1–38 refs (See N65-30250 19-10) CFSTI: $7.00

The article deals with equivalent transformations of networks due to replacement of subnetworks by their equivalent analogues. It is shown that for certain classes of automata and networks of functional elements, there exist finite systems of rules by means of which all the equivalent networks in a given class can be derived one from another. Author

N65-30252 Joint Publications Research Service, Washington, D. C.
SELF-CORRECTING NETWORKS OF FUNCTIONAL ELEMENTS
G. I. Kiriyenko *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 39–55 refs (See N65-30250 19-10) CFSTI: $7.00

This study is concerned with problems of the synthesis of self-correcting networks of functional elements, namely, networks in which part of the elements performs completely reliably (a reliable element always realizes a definite and corresponding function) while the other elements may sometimes perform incorrectly (an unreliable element, if correctly performing, realizes its specific function, while, if it performs incorrectly, it realizes any other function). In this connection, at any time instant, the "breakdown" of not more than R elements, where R is an arbitrary (but fixed) number, is possible. Author

N65-30253 Joint Publications Research Service, Washington, D. C.
TESTS FOR NONITERATIVE CONTACT NETWORKS
I. V. Kogan *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 56–66 refs (See N65-30250 19-10) CFSTI: $7.00

This study establishes that for an arbitrary noniterative contact network with n contacts it is possible to construct a test of a length not exceeding n + 1, clarifying the correct functioning of the network, in the presence of any malfunctions (of the short-circuiting type or contact-disruption type, in arbitrary combinations). Author

N65-30254 Joint Publications Research Service, Washington, D. C.
COMPLEXITY OF SERIES-PARALLEL CONTACT NETWORKS REALIZING A SEQUENCE OF BOOLEAN FUNCTIONS
R. Ye. Krichevskiy *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 87–86 refs (See N65-30250 19-10) CFSTI $7.00

Finding a minimal network of a specific form realizing a given Boolean function requires determination of the lower estimate of complexity of an arbitrary network. Formulas are derived to show the lower estimates of both an arbitrary series-parallel network and an arbitrary contact network of closing contacts. M.W.R.

N65-30255 Joint Publications Research Service, Washington, D. C.
REPRESENTATION OF FUNCTIONS BY NONITERATIVE SUPERPOSITIONS IN THREE-VALUED LOGIC
L. M. Sosinskiy *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 87–107 refs (See N65-30250 19-10) CFSTI: $7.00

It is shown that representations of the functions of two-valued logic as a noniterative superposition of formulas corresponding to nonseparable functions differ little from each other and can be extended to the case of k-valued logic. All the constructions are performed for a class of functions that strongly depend on all their arguments, which are defined. If k=2, this class coincides with the class of functions that essentially depend of their arguments. Some of the findings are extended for the case of any k value. Three-valued functions are also developed, and these include noncommutative functions. The constructed functions are subdivided into classes, and it is shown that pairs of these classes do not interpenetrate. M.W.R.

N65-30256 Joint Publications Research Service, Washington, D. C.
TREATMENT OF THE THEORY OF AUTOMATA BY METHODS OF THE THEORY OF RELATIONS
M. A. Spivak *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 108–162 refs (See N65-30250 19-10) CFSTI: $7.00

Basic results are presented which relate to the abstract theory of automata, particularly to the problem of synthesizing an automaton according to a specified response or a specified system of representable events. A modern apparatus of the algebra of sets, primarily of the algebra of binary relations, is utilized and described in detail. Subautomata, homomorphisms of automata, and synthesis of an automaton according to specified responses are considered. Representation of events in automata is discussed and the criterion for determining the representability of events in the finite automaton is presented with its proof. M.W.R.

N65-30257 Joint Publications Research Service, Washington, D. C.
COMPLEXITY OF THE NETWORKS REALIZING MULTIPARAMETRIC SETS OF OPERATORS
A. Trakhtenbrot *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 163–184 refs (See N65-30250 19-10) CFSTI: $7.00

Logic networks constructed from certain elements with multiparametric operators are considered. Statements are made regarding the upper and lower estimates of admissible trajectories, lemmas needed to prove these statements are established, and proofs are given for both the lemmas and statements. Canonical tables are suggested for obtaining the required estimates. M.W.R.

N65-30490# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
RESEARCH ON CROSSED-FIELD ELECTRON DEVICES Interim Scientific Report No. 2, Sep. 15, 1964–Mar. 15, 1965
T. A. De Massa, S. G. Lele, N. A. Masnari, J. E. Rowe, and V. K. Tripathi Mar. 1965 80 p refs
(Contract DA-36-039-AMC-00027(E))
(Rept.-05361-11S; AD-466928)

Cw operation of the S-band amplifier using the extended Kino gun has indicated essential agreement with theory and with earlier pulsed operation results. The extended gun was then replaced by the abbreviated Kino gun. The gun support structure has been modified in an attempt to eliminate the problem of beam interception by the fingers of the interdigital line. The corssed-field noise parameters have been evaluated for a modified version of the abbreviated Kino gun. These results are compared with those obtained previously for the original abbreviated gun. The results indicate that the noise parameters are affected by the laminarity of the electron beam. The computer presently is being programmed to evaluate the noise parameters in the crossed-field drift region. Author

N65-30495# Illinois Univ., Urbana. Coordinated Science Lab.
SENSITIVITY CONSIDERATIONS IN OPTIMAL SYSTEM DESIGN
R. A. Rohrer and M. Sobral, Jr. Jun. 1964 26 p refs
(Contract DA-28-043-AMC-00073(E))
(R-213; AD-443853)

The sensitivity of a control system is usually taken to be the normalized variation of some desired characteristic with the variation of plant or controller parameters. Rather than the usual absolute sensitivity described above, a new definition of relative sensitivity is introduced for the optimal control problem, wherein the system performance is always compared with its optimum under the given circumstances. The implications of the relative sensitivity and its relevance to optimal system design are discussed in detail. Moreover, a theoretical approach to the problem of system optimization when plant parameters are subject to change is presented. Author

N65-30638*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYTICAL DETERMINATION OF TRANSFER FUNCTIONS FOR RC COMMUTATED NETWORKS
S. N. Carroll Washington, NASA, Aug. 1965 30 p refs
(NASA-TN-D-2948) CFSTI: HC $2.00/MF $0.50 CSCL 09C

A method of analysis for obtaining the transfer functions for RC commutated networks is presented in this report. The method is illustrated by analyzing two configurations of a commutated network which were studied during the development of an adaptive tracking notch filter at Marshall Space Flight Center. The analysis is performed by generating a recurrence equation and the summation of two infinite series. The total frequency spectra for the commutated network output can be calculated using the input spectrum, the transfer function of the commutated network, and the transfer function of a linear filter. The results show the comparison between the frequency response using the theoretical transfer function and an actual RC commutated network. Author

N65-30737# Case Inst. of Tech., Cleveland, Ohio.
THE GYRATION OPERATOR IN NETWORK THEORY Scientific Report No. 7
R. J. Duffin, D. Hazony, and N. Morrison Jan. 1965 228 p refs
(Contract AF 19(628)-1699)
(AFCRL-65-249; AD-616329)

The gyration operator which generates a matrix from a given matrix is defined. It is shown that the gyration is related to the concept of combinatorial equivalence. The hybrid matrices of network theory are gyration matrices. The ABCD and hybrid matrices are combinatorially equivalent to their impedance and admittance matrices. All combinatorially equivalent matrices have the same degree. The gyration operator also preserves the PR property as well as the rank of the hermitian part. The gyration operators form an involutary Abelian group. The PR property is shown to extend beyond the impedance and admittance matrices of a passive network, and a complete set of PR matrices is given for the description of the network. Author

N65-30807# Joint Publications Research Service, Washington, D. C.
AUTOMATION AND RECOGNITION MODELS
O. I. Dotsenko et al 2 Aug. 1965 48 p refs Transl. into ENGLISH of 6 articles from Automatyka (Kiev), no. 2, 1965 p 8–16, 21–28, 39–60, 76–78
(JPRS-31350; TT-65-31847) CFSTI: $2.00

Several articles concerned with automation and recognition models are presented and include a radical engineering method of synthesizing an automatic regulator, optimum control without perturbation signals using a self-regulating model of the object, speech recognition, three-valued parametron logic in Post's algebra, the construction of a control automaton on ferrite transistor elements, and the reliability of recognition systems with positive feedback. R.N.A.

N65-30845*# Honeywell, Inc., Minneapolis, Minn. Military Products Group.
BOUNDED PHASE COORDINATE CONTROL Second Quarterly Progress Report, 15 Sep.–14 Dec. 1964
E. B. Lee and J. Y. Luh 6 Jan. 1965 31 p refs
(Contract NASw-986)
(NASA-CR-64312; Honeywell-MPG-12006-QR-2) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Development continued on computational procedures for optimal controls. Singular control (control while on the phase boundary) was investigated to provide additional information to assist in using the sufficient conditions for finding optimal controls. Examples demonstrate that information on the number of arcs on the phase boundaries and distributions between phase boundaries will assist in using the sufficient conditions to find the optimal controls. The appendix includes the theoretical development of a computational algorithm for approximation of bounded phase coordinate control by use of a penalty function. Computer simulations to determine its workability were initiated. R.N.A.

N65-30968# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
MINIMUM PEAK AMPLITUDE CONTROL
F. M. Waltz (Ph. D. Thesis) May 1965 198 p refs
(Contract DA-36-039-AMC-3733(E))
(TR-164; AD-616608)

This report considers a class of optimal control problems in which the input signal to a given system is to be chosen so as to cause the output of the system to satisfy specified conditions and so that the peak value of the input over the operating interval is a minimum. For cases in which the given system

is linear, a theorem guaranteeing the existence of an optimal input and a theorem giving the form of the optimal input are presented, as well as computational algorithms for obtaining numerical values of optimal inputs. Two approaches to minimum peak amplitude problems in which the given system in nonlinear are presented: the first makes use of a certain time-optimal problem, and the second involves a limiting process using an L sub p-space norm in place of the originally-specified cost functional. Author

N65-31087# Polytechnic Inst. of Brooklyn, N. Y.
INTERPOLATION ON THE REAL FREQUENCY AXIS
Lowell I. Smilen Griffiss AFB, N. Y., RADC, May 1965 22 p refs
(Contract AF 30(602)-2868)
(PIBMRI-1211-64; RADC-TR-65-128; AD-617260)

Interpolation, in the networks sense, involves the construction of a positive-real function which takes on a prescribed set of values at a given set of frequencies. The functions developed are rational in the complex variable $p = \sigma + jw$, but by a transformation of the form $\lambda = \tanh \gamma p$, a function capable of synthesis using commensurate line lengths and resistors is obtained. Thus networks applicable at microwave frequencies are derivable. The principal results are contained in a theorem which states that it is always possible to find a positive-real function, whose degree need not exceed $2n - 1$, which takes on a set of complex values with non-negative real parts, $R_i + jX_i$ at $p_i = jw_i$ ($i = 1, 2, \ldots n$). The proof contains an algorithm for the construction and synthesis of the resultant function. The network takes the form of a cascade of n-resistors and n-Brune sections terminated in an arbitrary positive-real function. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-30249# Radio Corp. of America, Camden, N. J. RCA Service Co. Div.
VALIDATION OF QUEUING TECHNIQUES FOR DETERMINING SYSTEM MANNING AND RELATED SUPPORT REQUIRMENTS
R. E. Purvis, W. K. Mallory, and R. L. Mc Laughlin Wright-Patterson AFB, Ohio, AMRL, Mar. 1965 135 p refs
(Contract AF 33(657)-11607)
(AMRL-TR-65-32; AD-615436)

A program was conducted to establish the validity and reliability of a technique of mathematical modeling for predicting manning requirements for weapon systems. The model was based on AMRL-TDR-64-21, "A Queuing Model for Determining System Manning and Related Support Requirements," and AMRL-TR-64-125, "Queuing Tables for Determining System Manning and Related Support Requirements." The technique was applied to two systems; the F105D fire control system (FCS), which presently is operational; and the C141 system, which is scheduled for operation in the near future. The model prediction for the FCS, using field data for parameter estimation, yielded good results when compared with operational performance. Moreover, it was shown that the operational performance could be achieved by 34% less personnel than the manning set by the table of organization. The model prediction for the FCS, using conceptual data, resulted in substantially the same manning for the maintenance shop as that developed from the measured data; but, because maintenance concepts had been changed in the field, the number of flightline airmen was larger than the measured data. The manning prediction for the C141 system, based on operational rates planned for the system and field data on the C130 system, resulted in a prediction of 819 airmen in the organizational maintenance squadron and 476 airmen in field maintenance squadron. With the predicted manning it could be expected that an operational readiness of 78% could be maintained. Author

N65-30493# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
OBSTACLE INFLUENCE IN A WIND TUNNEL
J. D. Horn Fort Monmouth, N. J., Army Electronic Command, Jul. 1965 31 p refs
(ECOM-5000; AD-466996)

Measurements of mean wind flow around models of the Athena launcher housing, Green River, Utah, were made in the USAERDAW wind research facility at White Sands Missile Range, New Mexico. These measurements were made in an effort to simulate obstacle effects of wind flow around the actual launcher housing. Wind perturbations occasioned by the launcher housing are considered a possible influence on wind sensor readings from a near-by meteorological pole. A series of mean velocity profiles taken in the lee of the two models in the wind tunnel is presented. Salient features of the profiles are pronounced attenuation below one obstacle height and relatively small changes with downstream distance over the limited range of distances measured. Author

N65-30518# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.
CHEMICAL MEANS FOR PREVENTION OF ACCUMULATION OF ICE, SNOW, AND SLUSH ON RUNWAYS Final Report
Jay C. Harris, J. R. Gibson, and D. Street Mar. 1965 109 p refs
(Contract FA-WA-4577)
(SRDS-65-13)

The objective was to develop a mixture capable of melting snow, ice, and slush at temperatures as low as −10° F. This mixture was to be of reasonable cost, be noncorrosive to aircraft and not cause deterioration of runway pavements. The prime candidate for runway deicing has the following composition: tripotassium phosphate 75%-formamide 25%. These materials are commercially available, and while their cost exceeds that of calcium chloride, the combination does not cause the extent of corrosion obtained with calcium chloride. While less satisfactory because of stress corrosion characteristics, a second combination proved outstanding for preventive corrosion of steel not under the potentially high stress of landing gear. Quite suitable for road or highway usage was calcium chloride to which was added 1% by weight of emulsifier STH. Author

N65-30527# Burroughs Corp., Paoli, Pa. Defense and Space Group.
MOD III COMPUTING SYSTEM, LAUNCH SUPPORT PROGRAM REPORT, EASTERN TEST RANGE. UNIVERSAL GROUND TEST PROGRAM, CLASSES II AND IV
J. Bradley, A. Goldman, L. Jenkins, and O. Orvis 11 Jun. 1965 57 p ref
(Contract AF 04(695)-690)
(Rept.-4411-65-239; AD-465812)

Described is the use and operation of the Universal Ground Test (UGT) program to be used with the modified Mod III computing system in various ground tests for different missions. Reprogramming minimized procedural changes in the field and optimized use of instruction memory space. The program routines are wired on four program core memory cards of the data exchange unit, and a sample test, utilizing the variable discretes and automated steering routines is presented to serve as a guide for UGT program analysis and use. Appendixes contain a glossary of terms, the input check routine, program flow charts, and the program assembly listing. G.G.

N65-30528# Burroughs Corp., Paoli, Pa. Defense and Space Group.
MOD III COMPUTING SYSTEM, LAUNCH SUPPORT PROGRAM REPORT, EASTERN TEST RANGE. SYSTEM CONFIDENCE PROGRAM, CLASSES II AND IV
J. Bradley, O. Orvis, and A. Goldman 11 Jun. 1965 40 p
(Contract AF 04(695)-690)
(Rept.-4411-65-241; AD-465813)

Presented is a complete description of the System Confidence Program and its two basic routines, the system confidence test routines and the auxiliary routines, to be used for verification of the Mod III Computing System equipment operation during countdown. These routines are wired into five program core memory cards of the data exchange unit and utilizes the K_2 reserved constants tray. The extent of the tests performed and the areas of involvement of the Mod III Computing System are discussed, and the displays and indicators for evaluation of the diagnostic tests executed by this program are described. Appendices contain a glossary of terms, program flow charts, and assembly listings. G.G.

N65-30532# Naval Ordnance Lab., White Oak, Md.
FORTRAN IV (IBM 7090) PROGRAM FOR THE DESIGN OF CONTOURED AXISYMMETRIC NOZZLES FOR HIGH TEMPERATURE AIR
Walter J. Glowacki Jul. 1965 77 p refs
(NOLTR-64-219; Aerodynamics Res. Rept.-235)

A computer program is presented for designing contoured axisymmetric nozzles when the supply air temperature is high enough to produce real gas effects. The real gas properties of high temperature air in thermodynamic equilibrium are computed using empirical equations and assuming that the air undergoes an isentropic expansion. These properties are used to determine the potential core contour by solving the inviscid flow equations by the method of characteristics. The turbulent boundary layer growth is computed from a numerical integration of the momentum integral equation and is added to the potential core to obtain the nozzle contour. The heat transfer rate is calculated from a form of Reynolds analogy. The computer program covering these phases of nozzle design is presented with the instructions necessary for using it. Author

N65-30594# Republic Aviation Corp., Farmingdale, N. Y.
LONGSHOT I HYPERSONIC FREE-PISTON TUNNEL
J. Christopher Boison May 1965 61 p refs Revised
(RAC-1884A, Rev.; SMSD-TR-65-4)

This report presents a complete description of the Republic Aviation Corporation Longshot I free-piston cycle hypersonic tunnel. Mechanical aspects as well as the free-piston cycle process are discussed. Instrumentation used and data acquisition and processing techniques are also described. Examples of actual data obtained in Longshot I are included. Author

N65-30596# Princeton Univ., N. J. Plasma Physics Lab.
TRANSMITTING MOTION THROUGH A VACUUM WALL
Robert S. Christie Jun. 1965 18 p
(Contract AT(30-1)-1238)
(MATT-345)

Mechanisms for transmitting motion through a vacuum wall and utilizing metal bellows as a vacuum seal are discussed and illustrated. Tests run on the mechanisms are described and the results related. The conclusion is drawn that metal bellows are satisfactory as a vacuum seal for all types of motions illustrated. Author

N65-30719*# Aircraft Armaments, Inc., Cockeysville, Md.
DESIGN STUDY OF A SPACE MOTION SIMULATOR Final Report
Mar. 1964 213 p refs
(Contract NAS9-1416)
(NASA-CR-65017; ER-3377) CFSTI: HC $6.00/MF $1.25 CSCL 14B

The partial solutions to those problems which were considered to be the most critical in preliminary design of a simulator are reported. This report consists of three phases: (1) redesign of simulator structure and computation of its vibratory response to external forces, in damped and undamped configurations; (2) further design and experimentation on harnesses to hold test subjects in the simulator; and (3) acquisition of date on maximum angular accelerations by which humans can accurately define the upper limits of rotational motion for the simulator under their own muscle power. It was concluded that the simulator was feasible and probably could be built to full size. Suitable support harnesses can be made to support test subjects in the simulator in shirtsleeves or full pressure suit, with or without a pack-pack propulsion unit while allowing nearly complete freedom, and use of arms and legs. It was also recommended that prior to the final design or during the initial stages of the design, a dynamic structural model of the simulator be constructed and subjected to vibration tests to verify the complex vibration analysis. R.W.H.

N65-30743# Naval Civil Engineering Lab., Port Hueneme, Calif.
PERMANENT SOUTH POLE STATION: DESIGN LIMITATIONS AND CONCEPTS
James E. Schroeder 4 Jan. 1961 49 p
(N-397; AD-612148)

This is a preliminary review of the construction limits affecting the final design of a permanent 25-man station at the South Pole; and the evaluation of 12-possible design concepts. The three principal limits selected as those which will have the greatest effect on the final design of the station are: (1) logistical requirements, (2) construction season and (3) construction force. For evaluation of design concepts three station types were considered—below grade, at grade and above grade; and four station layouts—train, semi-train, dispersed and composite. These 12 combinations were evaluated against ten station elements—mission and operation, construction effort, space utilization, structures, water supply, sanitation, air conditioning, fire protection, fuel and supply handling, and power generation and distribution. This resulted in a series of tables delineating the advantages and disadvantages introduced by each element for each concept. Author

N65-30776*# Spaco, Inc., Huntsville, Ala.
RESEARCH AND DEVELOPMENT IN THE FIELD OF PHYSICAL DETERMINATION OF MASS PROPERTIES Annual Report, Jun. 12, 1964–Jun. 12, 1965

Jun. 1965 301 p
(Contract NAS8-11314)
(NASA-CR-64160) CSCL 14B

In order to develop reliable and automatic measuring devices for physical determination of mass properties, studies were made of moment and product of inertia, principal axis, and center of gravity. Mass properties of dynamic liquid containers were also investigated to develop mathematical equations and parameters for application to launch and space vehicles. A "Period Decay Rate" concept was developed to determine moment of inertia experimentally with an accuracy of ±0.1%, and analytical curve fitting techniques were analyzed in this connection. Effects of dead weight, air bearing pressure, and external air drag on the damping constant were determined. A prototype system for measuring moment of inertia using a capacitive transducer for motion detection was designed, fabricated, and tested. A computer program for locating principal axis and an optical system for determining center of gravity were tested. Moment of inertia of a partially filled liquid tank oscillating about its yaw-pitch axis was determined in a test program. M.W.R.

N65-30828# Naval Ordnance Lab., White Oak, Md.
THE CONSTANT ACCELERATION GAS GUN PROBLEM. AN ANALYTICAL STUDY OF THE CONSTANT ACCELERATION GAS GUN PROBLEM AND THE EVALUATION OF SUGGESTED CONSTANT ACCELERATION GAS GUN SYSTEMS
Ernst H. Winkler May 1965 122 p refs
(Ballistics Res. Rept.-133; NOLTR-64-111; AD-615081)

An analytical study of the constant acceleration gas gun problem has been made. It has been shown that a necessary and sufficient condition exists which the propellant flow in the gun barrel must fulfill in order to maintain a constant pressure at the base of the projectile. The particular flow phenomenon which fulfills the required condition is characterized by the absence of any relative variation of flow velocity. The whole flow then is in a state of constant acceleration. The governing equation of this constant acceleration flow and the gradients which exist in it are derived. The conditions which must be produced in the gun chamber to generate a constant acceleration flow have been evaluated and the limitations imposed on its production are determined. A comparison is made of the pressure-time relation obtained from a free piston compressor and the required p-t relation to produce a constant acceleration flow. Various modifications of the pump chamber of a two-stage gun are investigated in order to determine the most suitable modification by which a constant acceleration gun can be realized. Author

N65-30829# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.
FEASIBILITY OF SIX-DEGREE-OF-FREEDOM GEM MODEL TESTING IN THE DAVID TAYLOR MODEL BASIN MANEUVERING AND SEAKEEPING FACILITY
Martin D. Fink May 1965 27 p refs Prepared for Bur. of Naval Weapons
(DTMB-2004; DTMB-AERO-1084; AD-466621)

Results of investigation of six-degree-of-freedom dynamic GEM model, tested in DTMB Maneuvering and Seakeeping (MASK) Facility over random seas of various states, are presented. Primary purpose of investigation was to study feasibility of six-degree-of-freedom GEM model testing in this facility. Data were obtained using a plenum-type, submerged sidewall model employing flexible cloth "skirts" for bow and compartmentation seals, and propelled by air escaping under aft flaps. Performance characteristics are evaluated in terms of kinetic energy of escaping air and model speed. Seakeeping characteristics are evaluated in terms of root-mean-square accelerations. With some qualifications, it is concluded that tests of this type are feasible and useful. Author

N65-30912# France. Office National d'Etudes et de Recherches Aérospatiales, Chatillon-sous-Bagneux.
EXPERIMENTAL PERFORMANCE OF A TRAVELING-WAVE ACCELERATOR [MESURE DES PERFORMANCES D'UN ACCELERATEUR A ONDES PROGRESSIVES]
Thiébault Moulin, Jacques Paulon, and Philippe Defranould 1965 28 p Presented at the 6th Symp. on Eng. Aspects of Magnetohydrodyn., Pittsburgh, 21–23 Apr. 1965
(ONERA-TP-235(1965))

The performance of a pulsed traveling wave experimental thrustor is described. The thrustor consists of a diverging annular channel surrounded by coils on each of its faces. Two different distributions of the coils and their connections were used and are described. Channel pressure, electromagnetic configuration without plasma, plasma flow, Hall effects, current density measurements, acceleration efficiency for traveling wave operation, and technological inaccuracy of the Rogowski coils are discussed. R.N.A.

N65-30948# Nuclide Corp., State College, Pa.
VACUUM VIBRATOR ION SOURCE, PHASE II Technical Report, Mar. 1964–Feb. 1965
L. A. Cambey and T. J. Hovick Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1965 23 p refs
(Contract AF 33(657)-11041)
(AFML-TR-65-81; AD-616741)

Two types of vacuum vibrator sources have been developed. Conventional magnetic reed types, or buzzers, operated at several hundred cps and resonant stepped horn systems operated at frequencies from 15 to 60 Kcps. The two types of sources have been tested on a double focusing mass spectrograph, and their characteristics studied. Techniques have been developed for the ionization of nonconductors with the vacuum vibrator source. Author

N65-31034*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-TEMPERATURE MIXER DEVELOPMENT
Kenneth R. Lorell 15 May 1965 18 p ref *Its* Sect. Rept.-375-7
(Contract NAS7-100)
(NASA-CR-64354) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Heat and mechanical load tests were conducted on a mockup of a solar simulator mixer to determine the feasibility of an experimental mixer design. The design consists of a compression band surrounding aluminum lens holders in which the outer circle of the mixer lenses are seated. Sapphire spheres are set into hemispherical cut-out areas in the lenses where any three form a junction. The spheres, along with the slight frictional forces produced by the compression band, allow the structure to support itself. The mixer mockup withstood both high temperatures for extended periods and heavy loads. A fracture appeared in one of the lenses during a high temperature run. The cause was attributed to thermal shock induced in the cooling phase of the previous run and was not a mechanical deficiency in the design. Although the design appears promising from the test results, it has not been subjected to combined heating and loading. R.N.A.

N65-31163# Bureau of Mines, Bartlesville, Okla.
PRESHOT AND POSTSHOT SAFETY SURVEY OF OIL AND GAS FACILITIES–BAXTERVILLE FIELD, MISSISSIPPI Final Report
Don C. Ward 5 Aug. 1965 73 p Sponsored by ARPA and AEC (VUF-1022) CFSTI: $3.00

Oil and gas wells and related facilities of the Baxterville field were surveyed to document any physical changes resulting from the Salmon Event. All such structures within a 5-mile radius of Ground Zero (GZ) were examined and photographed in detail. In addition, all wells and major facilities between the 5- and 6-mile radii, as well as other selected wells and facilities within a 10-mile radius of GZ, were examined and photographed. No damage was observed at any of the oil or gas wells or related facilities. Notes and photographic documentation are presented. E.E.B.

N65-31167# Naval Research Lab., Washington, D. C.
CALCULATIONS ON UNIFORM-FIELD BENDING MAGNETS Cyclotron Report No. 1
P. Shapiro, S. Podgor, and R. B. Theus 17 May 1965 34 p refs (NRL-6248; AD-619918)

The focal properties of some uniform-field bending magnets have been calculated. This report gives tables and graphs of the image distance and magnification for deflection angles of 20, 22-1/2, 35, 40, and 45 degrees, as a function of the object distance and the angle the particle beam makes with the entrance and exit faces of the magnet. These numerical results are useful when designing ion-optical systems for particle accelerators. Author

N65-31196# Perkin-Elmer Corp., Costa Mesa, Calif. Astro-Optical Div.
HIGH ENERGY PHOTOGRAPHIC PRINTING LIGHT SOURCE Final Report, Feb. 1964–Jun. 1965
Morris F. Brillhart 1965 39 p
(Contract AF 33(615)-1133)
(AFAL-TR-65-145; AD-467466)

An applied research program has been performed to produce a high energy photographic printing light source for exposure of high-resolution low-sensitivity non-silver-halide materials in a high-speed printer, that will produce 200 lines/mm to third generation. Two categories of light source were investigated, lasers and the plasma arc. The plasma arc was selected as the one light source presently available meeting the requirements for spectral emission, continuity of energy, and illumination output. An experimental apparatus has been constructed utilizing an optical system of reflectors and lenses. This optical system shapes the light from the light source to produce uniform illumination over the 10-inch dimension of the 1" × 10" aperture which is placed on the film plane. Operational tests were performed, demonstrating that the contract requirements have been met. Author

N65-31222# National Lead Co. of Ohio, Cincinnati. Feed Materials Production Center.
[THORIUM DETERMINATION IN AQUEOUS AND ORGANIC SOLUTIONS, NEUTRON ACTIVATION EQUIPMENT AND URANIUM ALLOY STUDIES] Summary Technical Report, Apr. 1–Jun. 30, 1965
R. Burgett and B. J. Thomas, ed. 11 Aug. 1965 71 p refs
(Contract AT(30-1)-1156)
(NLCO-955) CFSTI: $3.00

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4. STUDIES OF PRECIPITATION IN URANIUM-UAl_2 ALLOYS BY ELECTRON MICROSCOPY W. A. Althaus 7 p refs
5. DEVELOPMENT OF PROCEDURES FOR CASTING NPR BILLETS R. J. Lusky 16 p refs
6. URANIUM ROLLING TEST: CROSS-SECTIONAL SHAPES AND DEFORMATIONS PRODUCED BY THE SIX-STAND CONTINUOUS MILL H. W. Hesselbrock 9 p refs
7. SHEARING URANIUM RODS TO FUEL CORE BLANKS W. E. Stephens 7 p

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-30405 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROTATIONAL RELAXATION IN PLANE-PARALLEL RAREFACTION WAVE
V. N. Arkhipov and L. I. Severinov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 52–60 refs (See N65-30400 19-23)

Rotational relaxation in a plane-parallel rarefaction wave is investigated by the method of characteristics. It is shown that the effects of relaxation strongly depend on relaxation time and that the influence of relaxation processes during flow around an obtuse angle is considerable. E.E.B.

N65-30406 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF DIFFERENTIAL EJECTOR
B. A. Uryukov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 61–71 (See N65-30400 19-23)

The differential ejector was investigated in order to clarify the characteristics of multistage ejectors. It is shown that the multistage ejector can give very large increases in compression ratio. Also, the narrowing of mixing chambers of elementary stages increases the compression ratio. Equations are derived for ejector optimization and ejector efficiency. E.E.B.

N65-30407 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CALCULATION OF THERMAL DIFFUSION IN LAMINAR FLOW OF VISCOUS LIQUID AT MODERATE VALUES OF THERMAL AND DIFFUSION PRANDTL NUMBERS
A. M. Suponitskiy *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 72–80 refs (See N65-30400 19-23)

The calculation of thermal diffusion separation at moderate values of Prandtl numbers and the theory of thermal diffusion separation in forced flow of viscous fluids are considered. Equations are derived to describe the separation process and the significance of results is discussed. E.E.B.

N65-30408 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON FLOWS OF LIQUID WITH FORMATION OF CLOSED CAVITATION CAVITIES

A. Ye. Khoperskov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 81–90 refs (See N65-30400 19-23)

The problem of fluid flow in an infinite region with a curvilinear boundary is considered. A method for the solution of this problem is presented which will also apply to the analogous problem of flow in curvilinear channels. The problem is reduced to the solution of an integral equation and the significance of results is discussed. E.E.B.

N65-30415 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FORMING OF SHOCK WAVE AND SCATTERING OF PRODUCTS OF EXPLOSION IN AIR

V. V. Adushkin *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 164–178 refs (See N65-30400 19-23)

Shock wave propagation and the movements of explosion products for an atmospheric detonation were studied with piezoelectric pressure gauge, high-speed photography, and ionization probes. Also, the distribution of energy between the shock front and the explosion products was considered. Equations are given for the determination of parameters for the significant characteristics of atmospheric detonations. E.E.B.

N65-30442 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANALYSIS OF FLOW AROUND BLUNT BODIES WITH DETACHED SHOCK WAVE BY AN EQUILIBRIUM DISSOCIATING GAS

O. M. Belotserkovskiy, M. M. Golomazov, and N. P. Shulishnina *In its* J. of Computer Math. and Mathematical Phys. 15 Mar. 1965 p 1–16 refs (See N65-30441 19-19)

The problem of symmetrical flow around blunt bodies with detached shock wave by an ideal equilibrium dissociating gas is considered. A method based on the integral relations was applied introducing approximations of functions with respect to one of the variables. Partial differential equations are then replaced by a system of ordinary differential equations and solved. These calculations were applied to the analyses of bodies with complicated shape and to those cases when the shock layer becomes comparatively thin. W.M.R.

N65-30453*# Oklahoma State Univ., Stillwater. Fluid Power Controls Lab.

STUDY OF FLUID TRANSIENTS IN CLOSED CONDUITS Annual Report No. 1

E. C. Fitch, J. D. Parker, C. R. Gerlach, H. C. Hewitt, G. Maples et al 15 Jul. 1965 240 p refs

(Contract NAS8-11302)

(NASA-CR-64186) CFSTI: HC $6.00/MF $1.25 CSCL 20D

This project has been concerned with the development of applicable theory and techniques for predicting transient flow behavior in single phase fluid systems. In addition, the properties and flow characteristics of cryogenic fluids which influence analytical simulation studies are being investigated. The research associated with this project has been relegated to two research teams. The first team is charged with the development of appropriate theory and techniques for establishing a conduit model. The second team has undertaken the investigation of cryogenic properties and flow characteristics. This article reports the project activities and efforts for the first year of the study. N.E.A.

N65-30470*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

COMPARISON OF MASS LIMITING TWO-PHASE FLOW IN A STRAIGHT TUBE AND IN A NOZZLE

D. K. Edmonds and R. V. Smith [1964] 19 p refs

(NASA Order R-45)

(NASA-CR-64098) CFSTI: HC $1.00/MF $0.50 CSCL 20D

This paper reports the experimental data obtained at mass-limiting and near-mass-limiting conditions for a straight tube and two nozzle test sections. The experimental system was a Refrigerant 11 flow loop. Fluid qualities entering the test sections were 0.042, 0.116, and 0.156. It was noted that as the pressure differential between the exit-plane and the receiver was increased, the exit-plane pressure approached a constant value, for all test sections. The mass flow also approached a constant value for the straight tube, but for the nozzles the mass flow continued to increase with increasing differential pressure but at a lower rate of increase. The deviations from the straight tube behavior were greater for the nozzle with the largest angle of convergence. Predicted mass-limiting flow rates from the Fauske and a metastable model were compared with the experimental data. The models adequately predicted the flow rate for data where the exit-plane pressure was almost constant (within ±30%). Author

N65-30491# Illinois Univ., Urbana. Dept. of Chemistry and Chemical Engineering.

INVESTIGATION OF WALL TURBULENCE USING A DIFFUSION-CONTROLLED ELECTRODE

James E. Mitchell (Ph.D. Thesis) Jul. 1965 159 p refs *Its* Rept.-1

(Grant AF-AFOSR-547-65)

(AFOSR-SR-65-1199; AD-466538)

This study was performed to demonstrate that a diffusion-controlled electrode technique can be used to measure the average and fluctuating shear stresses at a pipe wall and to obtain a better understanding of the structure of turbulence near the wall. The technique was established after compensations for two effects, also common to the hot wire anemometer, were determined. The problem of non-uniform flow across the electrode was solved by determining experimentally a correction factor, whereas the problem of the time response of the electrode to fluctuations in the shear stress was handled by numerically solving the governing equations. The data for fully developed turbulence showed that the limiting velocity intensity at the wall was 0.32, based on the local average velocity, and that it was independent of Reynolds number. The circumferential scale was found to be very small near the wall but the longitudinal scale did not decrease from the values reported for the center of a pipe. Some velocity disturbances near the wall appeared to be as large as the local average velocity. A simplified model for a low frequency disturbance near the wall was investigated and found to be promising although several of the assumptions were not well substantiated. Author

N65-30519# Los Alamos Scientific Lab., N. Mex.

STABILITY OF DETONATIONS FOR DISTURBANCES OF SMALL TRANSVERSE WAVELENGTH

Jerome J. Erpenbeck 3 Aug. 1965 137 p refs

(Contract W-7405-ENG-36)

(LA-3306) CFSTI: $4.00

The stability of one-dimensional steady detonations to periodic disturbances transverse to the flow is examined in the limit of small wavelength. The asymptotic criterion for stability is found to depend on the steady state profile of $c_0^2 - u^2$ (where c_0 is the frozen sound speed and u is the mass velocity relative

to the von Neumann shock) as a function of distance behind the shock. Detonations for which $c_0^2 - u^2$ decreases monotonically are found to be stable, but stability in cases where this quantity increases monotonically or up to a maximum is determined through simple integral functions of the steady flow variables. The asymptotic result can be applied to any detonation regardless of the number of chemical reactions which occur, provided knowledge of the equation of state and reaction kinetics is at hand. The criterion is applied to an idealized one-reaction detonation. Unstable regimes are found only if the ratio of specific heats is less than 2, in which case all detonations are unstable for large values of the activation energy. For low heats of reaction, instability persists for all heats unless the activation energy is also small. R.N.A.

N65-30530# Library of Congress, Washington, D. C. Aerospace Technology Div.
MIXING OF CONCENTRIC HIGH-VELOCITY AIRSTREAMS Surveys of Soviet-Bloc Scientific and Technical Literature, Jan.–Oct. 1964
12 Jul. 1965 52 p refs Compilation of Abstracts
(ATD-P-65-41; AD-466193)

A compilation of abstracts is presented on the mixing of concentric high-velocity airstreams. Among the topics included are reports on: (1) effect of the initial mass flow rate on the development of a submerged, nonisothermal, annular jet in an incompressible fluid; (2) calculation of the main section of an axisymmetric turbulent jet of a real gas; (3) flame stabilization with countercurrent jets; (4) stagnation temperature of a two-phase turbulent jet in a high-velocity gas stream; (5) numerical calculation of turbulent mixing of two homogeneous gas streams; and (6) calculation of trajectories and penetration ranges of fan and twin plane jets in a confined transverse flow. Graphical results are given for each study. C.T.C.

N65-30573# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXPERIMENTAL INVESTIGATION OF THE POSITION OF DETACHED SHOCKS IN REAL GASES
N. G. Maslennikov, I. G. Pariiskii, S. I. Rozov, and A. M. Studenkov 8 Jun. 1964 8 p refs Transl. into ENGLISH from Prikl. Mekhan. i. Tekhn. Fiz. (USSR), no. 1, 1965 p 98–102

A method is proposed to measure the bow shockwave standoff from the surface of a freely flying blunt body. The influence of the excitation of vibrational degrees of freedom of the gas on the detached shockwave position has been investigated in air and in carbon dioxide gas. N.E.A.

N65-30642# France. Ministere de l'Air, Paris.
AERODYNAMIC DEVIATION OF A SUPERSONIC JET BY PARIETAL INJECTION [DEVIATION AERODYNAMIQUE D'UN JET SUPERSONIQUE PAR INJECTION PARIETALE]
Jean Allègre Serv. de Doc. Sci. et Tech. de L'Armement, 1965 93 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 415

The configuration of the interaction caused by a gaseous jet injected parietally into the supersonic flow of a blast tube is studied. Dynamic effects resulting from the interaction are also reviewed. Quantitative measurements associated with the vibrations are used to define characteristics essential to the structure of the flow. The results confirm the effectiveness of the method, and are directly applicable to the directional control of space vehicles. Transl. by G.A.L.

N65-30689# Minnesota Univ., Minneapolis. Inst. of Tech.
A STUDY OF BURGERS' MODEL EQUATION OF TURBULENCE
Dah-Teng Jeng May 1965 48 p
(Contract Nonr-710(40))
(TR-3; AD-616610)

From a study of Burger's model equation of turbulence, it is shown that the turbulence generated by the model equation yields good approximation to real turbulence. The energy spectrum falls off like k^{-2} for times greater than 6 seconds. It is also shown that the energy spectrum of turbulence generated by the model equation follows the k^{-2}-law. The spectrum obtained by the Wiener-Hermite expansion of the model equation and the spectrum of real turbulence show the same results. It is concluded that the probability distribution of turbulence velocity fields becomes almost Gaussian distribution even though one may start with a non-Gaussian distribution. N.E.A.

N65-30691# Heliodyne Corp., Los Angeles, Calif.
A NEW QUASI ONE-DIMENSIONAL MODEL FOR TURBULENT WAKE MIXING
Andrew P. Proudian Jan. 1964 32 p refs
(Contract DA-04-495-ORD-3574(Z); ARPA Order 360-62; Proj. Defender)
(RN-13; AD-427686)

The model, which appears supported by laboratory experiments and which is made plausible on physical grounds, considers the wake as consisting of a "marble cake" structure of hot and cold lumps, the cold lumps being mixed into the wake by the large eddies of the turbulent wake. A dynamical (one-dimensional) model for the mixing leads to a simple set of equations which can be numerically integrated to yield the temperature, density and velocity of the hot and cold wake components. The inclusion of chemistry in the model would yield wake composition. The model permits the prediction of mean square mass and electron density fluctuations. The fluctuations are assumed to arise from random convection of inhomogeneous fluid elements, rather than by compressibility effects or dissipation associated with the turbulent velocity field. The consequences of such mixing for the spectrum of a scalar additive in a wake are qualitatively discussed. Comparison of predicted values of gas density fluctuation with experimental results show encouraging agreement, and warrant further development of the model. Author

N65-30705# Oklahoma Univ., Norman.
THE EFFECT OF SOUND WAVES AND FLEXIBLE BOUNDARIES ON TURBULENCE
Donald Herbert Fisher (M.S. Thesis) 1965 49 p refs
(Contract AF 33(608)-1096)
(AD-616713)

Research was conducted on separation of boundary layers on airfoils at high angles of attack, and skin friction drag in laminar and turbulent boundary layers on airfoils at low angles of attack. TAB

N65-30758# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF SHADOWGRAPH MEASUREMENTS FOR QUALITATIVE RESEARCH OF A SUPERSONIC FLOW AROUND A WING PROFILE
L. A. Vasil'Yev and V. P. Minina 1 Apr. 1965 12 p Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 8, no. 5, 1963 p 337–342
(FTD-TT-64-1064/1+2; AD-614389)

The use of the shadowgraph method for determining gas density distribution around a wing profile in supersonic flow was investigated. The experiments were conducted on an aerodynamic tube with a plane flow at Mach number of 1.51. The profile with a length of 600 mm was set up in such a manner that its generatrix coincided with the direction of the

line along which the characteristics of the flow were constant and was parallel to the optical axis of the shadow instrument. The ends of the model were firmly pressed to the protecting glass of the working chamber of the aerodynamic tube. In this way, the influence of boundary effects was avoided. It was shown that the shadow method of the slit and the filament in the focus can be successfully applied to the investigation of the flow around models of a supersonic flow with a figure for the angles of inclination of about 3×10^{-4} radian and sufficiently large dimensions of the model. The density distribution corresponded well with the theoretical and enabled the peculiarities which arise from the deviations of the conditions of the experiment from ideal to be evaluated. E.E.B.

N65-30764# Brown Univ., Providence, R. I. Div. of Engineering.

ABSORPTION AND EMISSION CHARACTERISTICS OF AN IDEAL RADIATING GAS

Merwin Sibulkin Apr. 1965 45 p refs

(Contract Nonr-(562)35)

(NONR (562)35/7; AD-614640)

An approximate analysis of the radiative properties of gases is presented for use in problems of fluid mechanics involving radiative transfer of energy. Results are obtained for both line and continuum spectral absorption coefficients as functions of frequency and temperature. The corresponding emission coefficients are integrated to obtain Planck mean absorption coefficients. These results are presented in a nondimensional form which clarifies their meaning and gives insight into the numerical magnitudes of significant radiative properties. It is found, for example, that for monatomic gases in the temperature range considered, $T < 30{,}000°$ K (say), the emission from atomic lines always exceeds that from the continuum. After comparing the photon mean free paths with the particle mean free paths, it is found that the Planck photon mfp is much longer than the particle mfp but that the photon mfp corresponding to the peak line absorption coefficient is much shorter than the particle mfp. Author

N65-30771# American Meteorological Society, Boston, Mass.

SHOCK WAVE PROPAGATION IN A NONHOMOGENEOUS ATMOSPHERE IN THE DIRECTION OF DECREASING DENSITY [RASPROSTRANENIE UDARNOI VOLNY V NEODNORODNOI ATMOSFERE V STORONU UMEN'SHENIIA PLOTNOSTI]

Iu. P. Raizer Bedford, Mass., AFCRL, Apr. 1965 16 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 4, 1964 p 49–56

(Contract AF 19(628)-3880)

(T-R-461; AD-616733)

This paper includes a solution of the self-modeling problem of the propagation of a plane shock wave in a nonhomogeneous atmosphere whose density varies exponentially (barometrically) in space. The shock wave travels in the direction of decreasing density. There is also a discussion of the self-modeling escape of a gas into a vacuum, which occurs after a shock wave departs into infinity and disappears. The data obtained can be used for an approximate description of an upper flow pattern produced by a violent explosion in a nonhomogeneous atmosphere. Author

N65-30862# Toronto Univ. (Ontario). Inst. for Aerospace Studies

FREE MOLECULE FLOW THROUGH AXI-SYMMETRIC TUBES

S. J. Townsend Mar. 1965 130 p refs

(Grant AF-AFOSR-276-64)

(UTIAS-106; AFOSR-65-0749; AD-616615)

Free molecule flow through axi-symmetric tubes having convex curved walls is considered. Diffuse reflection at the wall is assumed. The temperature profile along the wall has been considered to be a variable. Expressions for the convection of mass, axial momentum and energy are derived. Total flow quantities and the radial variation of these quantities across the entrance and exit planes are considered. Expressions are also given for the density and pressure fields within the tube. The results indicate that certain combinations of geometry and wall temperature profile can produce a net thrust on the internal system. Author

N65-30875# Minnesota Univ., Minneapolis. Dept. of Aeronautics and Engineering Mechanics.

FORMULATION OF STABILITY OF PLANE POISEUILLE FLOW WITH TEMPERATURE-DEPENDENT VARIABLE VISCOSITY

T. S. Fu May 1965 18 p refs

(Contract Nonr-710(40))

(TR-2; AD-616609)

The present investigation is a preliminary effort toward understanding the effect of temperature-dependent variable viscosity on hydrodynamic stability. The flow pattern chosen in this work is plane Poiseuille flow which predicts no inviscid instability for constant viscosity. By taking into account the variation of viscosity, it is found that the velocity profile of the basic flow possess a vorticity maximum. This might suggest instability for large Reynolds number. The stability equations and the boundary conditions are derived to compare with those of constant viscosity. Author

N65-30900# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

FULLY DEVELOPED TURBULENT SUPERSONIC FLOW IN RECTANGULAR CHANNELS

J. Kenneth Richmond and Raymond Goldstein May 1965 49 p refs *Its* Rept.-98

(DI-82-0441)

In order to assess properly the gas dynamic aspects of MHD channel flow it is necessary to obtain details of the flow conditions before fields are applied. In a channel with an entrance cross section of one cm square, with lengths up to 20 cm, at a Mach number of about 1.5 and at static pressures approaching one atm, a turbulent boundary layer fills the channel, and fully developed pipe flow turbulence prevails. A simple one-dimensional theory is presented for this case, relating stagnation pressure change to area change, heat transfer and friction factor. Experiments are described in which a supersonic flow of heated or cold argon was passed into the channel, and the flow rate and temperature varied to cover a range of Reynolds numbers (based on channel width) from 5,000 to 500,000. Total pressure and total temperature changes are correlated with the theory. Author

N65-30957*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

A MODEL FOR CHEMICALLY REACTING NITROGEN-OXYGEN MIXTURES WITH APPLICATION TO NONEQUILIBRIUM AIR FLOW

Walter A. Reinhardt and Barrett S. Baldwin, Jr. Washington, NASA, Aug. 1965 41 p refs

(NASA-TN-D-2971) CFSTI: HC $2.00/MF $0.50 CSCL 20D

An air model is presented that is relatively simple yet quantitatively realistic for use in computing chemical nonequilibrium in a flow field. Such a model is applicable to those computational problems associated with high-speed reentry where the effect of the nonequilibrium processes on the primary

flow variables would be important, but where the details of these processes would be of secondary interest. The constituents that comprise the system are N_2, O_2, N, O, N^+, O^+, and e^-. The dissociation-recombination reactions of N_2, O_2, and NO as well as the bimolecular exchange reactions are considered. However, the presence of NO is accounted for in an approximate manner to avoid coupling in the atom conservation equations. The model allows for the inclusion of either nonequilibrium or equilibrium vibration while ionization is taken to be in equilibrium. The resulting rate equations are in a form that may be integrated over local values of the flow variables to obtain a system of transcendental equations that can be solved by iteration. Comparisons with experimental nozzle flow results and with other numerical calculations are presented. Author

N65-30978# Pittsburgh Univ., Pa.
DETERMINATION OF THE RELATIONSHIP OF CONSTRICTION PRESSURE LOSS TO THE RE-EXPANSION LOSS IN SUDDEN REDUCTION OF CROSS-SECTIONAL AREA FOR A SINGLE PHASE FLUID FLOW
Charles Edward Dorgan (M.S. Thesis) 1965 99 p refs
(Contract AF 33(608)-1104)
(AD-617066)

The purpose of the thesis is to investigate the relative losses in pipes for sudden contraction of a single phase fluid. A sudden contraction is defined as an immediate reduction in the flow cross sectional area. The objectives are to determine the losses of a sudden contraction by experimental tests and correlate these losses with the various flow parameters. Author

N65-30983# Alaska Univ., College. Geophysical Inst.
COLLEGE OBLIQUE IONOGRAMS
Howard F. Bates and Arthur Goddard Mar. 1964 23 p refs
(UAG-R147)

This report illustrates some of the typical backscatter echoes observed at College, Alaska. Backscatter soundings are being made in five directions— 015, 105, 210, 270, and 325 degrees true bearing. The majority of the echoes seen were not groundscatter as usually defined. Many echoes from the northern directions were, in fact, direct scatter echoes from the ionosphere. Groundscatter echoes were regularly observed from the south during this past winter, but only rarely from the north. Sample forward oblique ionograms recorded over the Andoya, Norway, to College, Alaska, path are shown. Preliminary results indicate that the signals were primarily propagated via E or Es layers. Signals with delays of 3 to 10 milliseconds over the great-circle path delay were quite common on all the paths monitored at College. The sample records shown contain signals with delays of 4 to 5 milliseconds. Author

N65-31075# New York Univ., N. Y.
THE RADIAL VARIATION OF THE EDDY VISCOSITY IN COMPRESSIBLE TURBULENT JET FLOWS **Interim Report**
Victor Zakkay and Egon Krause Wright-Patterson AFB, Ohio, ARL, May 1965 36 p refs
(Contract AF 33(616)-1516)
(ARL-65-89; AD-617701)

The radial variation of the eddy viscosity in heterogeneous compressible turbulent jet flows is investigated. Radial distributions of ϵ/ϵ_ξ and $\rho\epsilon/(\rho\epsilon)_\xi$ are determined in the mixing region of two coaxial jets. The momentum equation is solved for the viscosity coefficient and values thereof are obtained by using experimental velocity and concentration profiles. The turbulent Pt, Sc, and Le numbers are assumed to be unity. Three different injection gases are considered. Hydrogen, argon and xenon are assumed to exhaust through the center jet into an air stream moving at a constant supersonic velocity. The dependence of ϵ and $\rho\epsilon$ on the velocity ratio u_j/u_e is investigated and the results are compared with the transformation as suggested by Ting and Libby for the compressible eddy viscosity. Author

N65-31094# Royal Aircraft Establishment, Bedford (England).
THE SURFACE OIL FLOW TECHNIQUE AS USED IN HIGH SPEED WIND TUNNELS IN THE UNITED KINGDOM
A. Stanbrook London, Min. of Aviation, Aug. 1960 25 p refs
(RAE-TN-AERO-2712)

An examination has been made of the various versions of the surface oil flow technique used in different high speed wind tunnels. To provide background information some systematic tests were made on a simple model in a small supersonic tunnel. The experience gained made it possible to explain many of the variations in terms of the different operating conditions of the tunnels. The time taken to form a pattern on a typical model, is, to a first approximation, directly proportional to the value of the parameter $\mu_{oil}/q\ c_f$, where μ is the absolute viscosity and $q\ c_f$ is laminar flow, the factor being $36\,000 \pm 12\,000$. The time taken appears to be independent of the initial thickness of the oil sheet. C.T.C.

N65-31095# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF THE TURBULENT FRICTION OF FLUIDS IN POLISHED PIPES [CONTRIBUTION A L'ETUDE DU FROTTEMENT TURBULENT DES FLUIDES EN CONDUITES LISSES]
Jean-Paul Hettler 1965 102 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 414

A kinematic study of fluid flow in a smooth cylindrical pipe with circular cross section in a turbulent system was made. A critical exposition of the work of Prandtl–Nikuradse and their successors is presented. A description of the equipment and experimental techniques used is provided. Results reported include: the visualization and direct observation of the laminated substratum; measurement of instantaneous velocity within the pipe by means of the double spark injection of fine photographic particles; and the establishment of velocity profiles. Bibliographic references are included. Transl. by G.A.L.

N65-31212# Applicazioni e Ricerche Scientifiche, Milan (Italy).
NUMERICAL EXPERIMENTS ON THE PROPAGATION OF SHOCKS IN A POLITROPIC GAS
L. Guerri (EURATOM) and A. Taroni Brussels, EURATOM, 1965 73 p refs
(Contract EURATOM-009-62-7 FUAI)
(EUR-2300.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 100 Belg. Fr.

Various one-dimensional hydrodynamic problems in Lagrangian coordinates are considered in order to study the formation and character of some irregularities, in particular a rarefaction, which appear in the numerical treatment of shock problems. These irregularities develop when there is a discontinuity in the initial data. Besides the usual pseudo-viscosity, a pseudo-thermal diffusion is introduced which gradually smoothes out the rarefaction. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-30194# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
AGE HARDENING OF SNOW AT THE SOUTH POLE
Anthony J. Gow and Rene O. Ramseier Nov. 1964 34 p refs
(CRREL-RR-112; AD-614430)

The age hardening of artificially and naturally compacted snow has been investigated at the South Pole. Results show that the age-hardening process is greatly retarded at low temperatures. Artificially compacted samples of density 0.55 g/cm^3 attained a compressive strength of less than 3.0 kg/cm^2 after one year's aging at −49C. Exposure to solar radiation accelerated the age hardening. Irradiated samples attained a strength of 6.0 kg/cm^2 after 100 hr, increasing to a virtual maximum of 8.0 kg/cm^2 at 600 hr. Compressive strengths increased with a decrease in snow-particle size and with an increasing angularity of the particles. Below 3 m the strength of naturally compacted snow was found to increase rapidly with an increase in density. Naturally compacted snow of density 0.55 g/cm^3 possessed considerably greater strength than any of the age-hardened samples of artificially compacted snow of the same density. Thin-section studies show that age hardening can be correlated with the formation and growth of intergranular bonds, and that bond growth falls off rapidly with decreasing temperature. In view of the low strength found in both naturally and artificially compacted snow at the South Pole, "cut-and-cover" undersnow camp construction may not prove practical at the South Pole. Author

N65-30200# Minnesota Univ., Minneapolis. School of Physics.
ATMOSPHERIC PHYSICS RESEARCH Annual Progress Report
May 1965 36 p refs
(Contract Nonr-710(22))
(AD-617185)

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6. ATMOSPHERIC DUST J. M. Rosen p 22–32 (See N65-30206 19-13)

N65-30201 Minnesota Univ., Minneapolis.
ATMOSPHERIC MOTION
Homer T. Mantis *In its* Atmospheric Phys. Res. May 1965 p 1–5 refs (See N65-30200 19-13)

A study of the relationship between the fields of motion and pressure in the atmosphere was directed toward isolating motions of weather map scale from those of smaller scale. An equation of the horizontal atmospheric motions is given with an ultimate aim of estimating the magnitude of the frictional term. An indirect method was developed by first analyzing the pressure field and then searching for relations between the departure of the observed wind from the smoothed geostrophic value. Various methods were explored for the objective analysis of the pressure field, and a final calculation of geostrophic wind was made by fitting a second degree polynomial to a larger number of height values by the method of least squares. Pilot calculations of geostrophic departures were made for two closely spaced upper air stations, and the departure at each station was found to be smaller than the difference between the observed winds. C.T.C.

N65-30202 Minnesota Univ., Minneapolis.
STELLAR EXTINCTION MEASUREMENTS FROM BALLOONS
E. P. Ney *In its* Atmospheric Phys. Res. May 1965 p 6 (See N65-30200 19-13)

In order to extend the measurements of dust to above balloon altitudes, a photometric method of observing stellar extinction was devised. A rotating photometer mounted beneath the balloon observes the region of the sky just above the horizontal and including the horizon, and variation in extinction with the change in elevation angle of the star can be measured accurately. Analysis showed that half the extinction at high altitude must be due to larger particles rather than Rayleigh scattering by the air. Flights were made which yielded estimates of the dust concentration at balloon altitudes that are in agreement with previous direct measurements; on one flight it was discovered that scintillation occurs in atmospheric paths above 30 km. C.T.C.

N65-30203 Minnesota Univ., Minneapolis.
SOLAR CORONAL EXPERIMENTS
E. P. Ney *In its* Atmospheric Phys. Res. May 1965 p 7 (See N65-30200 19-13)

Plans for solar eclipse experiments are briefly outlined, and the equipment to be used is mentioned. Ground based experiments will be supplemented by balloon borne cameras and telemetering polarimeters for measuring polarization in the region between 5 and 20 solar radii. C.T.C.

N65-30204 Minnesota Univ., Minneapolis.
STRUCTURE OF THE LOWER STRATOSPHERE
John L. Kroening *In its* Atmospheric Phys. Res. May 1965 p 8–11 (See N65-30200 19-13)

Variations in the thicknesses of laminae, found in the lower stratosphere, the upper troposphere, and more often in the tropopause, are discussed. Different layers have been detected with the smallest one having a total thickness of only 100 meters. A crude calculation is presented for evaluating the importance of these layers in determining stratospheric residence times. Soundings of ozone and dust are reported, and it is suspected that the position of the level of maximum ozone concentration is not determined by the photochemical equilibrium but rather by diffusion. C.T.C.

N65-30205 Minnesota Univ., Minneapolis.
OPTICAL RADAR PROBE
John L. Kroening *In its* Atmospheric Phys. Res. May 1965 p 12–21 refs (See N65-30200 19-13)

To supplement the aerosol soundings made with the photoelectric particle counter aboard balloons, a 6943 Å ruby laser is used in an optical radar system for studying the stratospheric aerosol. Graphs are included of vertical ozone distribution, wind speed and direction, and vertical ozone and dust distribution measured simultaneously. C.T.C.

N65-30206 Minnesota Univ., Minneapolis.
ATMOSPHERIC DUST
James M. Rosen *In its* Atmospheric Phys. Res. May 1965 p 22–32 (See N65-30200 19-13)

A photoelectric particle counter was used in a study of atmospheric dust. Based on dust soundings over a two year period, the following generalizations were made: (1) The concentration and structure of dust in the 100 to 200 mb level is variable and seems to depend mainly on the temperature structure. (2) The dust concentration at 100 mb is always 2 to 3 per cm^3; the only exception was the sounding made during the presence of the Bali dust associated with the eruption. (3) The dust concentration follows a roughly constant mixing ratio in the stratosphere. (4) There is a high correlation between the fine structure in the dust and temperature profiles. The Bali dust has been clearly distinguished and appears between the 100 and 200 mb level. Also reported is the development of an improved photoelectric dust counter which counts particles down to .25μ diameter. C.T.C.

N65-30272# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
DATA PREVIOUS TO THE INTERNATIONAL GEOPHYSICAL YEAR I: 5577[OI] LINE AT SACRAMENTO PEAK, NEW MEXICO
G. J. Hernandez May 1965 56 p refs *Its* Environ. Res. Papers, No. 104
(AFCRL-65-319; AD-617248)

Zenith intensity measurements of the 5577 [OI] green line of the nightglow are presented in tabular form. A discussion on the present knowledge of the night airglow features, instrumentation, and calibration of the instruments is also included. Author

N65-30350*# Woods Hole Oceanographic Institution, Mass.
OCEANOGRAPHY FROM SPACE
Gifford C. Ewing, ed. Apr. 1965 445 p refs Proc. of Conf. on the Feasibility of Conducting Oceanographic Explorations from Aircraft, Woods Hole, Mass. 24–28 Aug. 1964 *Its* Ref. No. 65-10
(Contract NsR-22-014-003)
(NASA-CR-64164) CFSTI: HC $7.45/MF $2.25 CSCL 08

Selected articles on the physical, biological, chemical, and geological aspects of oceanography are presented. For individual titles see N65-30351–N65-30396.

N65-30351* General Electric Co., Utica, N. Y. Light Military Electronics Dept.
OCEANOGRAPHIC SATELLITE RADAR ALTIMETER AND WIND SEA SENSOR
Thomas W. Godbey *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 21–26 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

The measurement of both local wind-sea state and altitude by a radar altimeter operating from a satellite, of use to both the oceanographic and geodetic communities, is described. With present state of-the-art, it is considered feasible to obtain altitude measurements from a satellite over the ocean with only five ft standard error per measurement. Pulsed radar altimeter characteristics are tabulated and a timing error budget for the proposed altimeter is given. The average radar cross section per unit area is plotted as a function of angle of incidence. M.W.R.

N65-30352* Coast and Geodetic Survey, Washington, D. C.
SEA LEVEL AND TSUNAMIS
H. B. Stewart, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 27–28 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Satellite and spacecraft observations may be of use in obtaining information about the wave coupling mechanism between the ocean bottom and the water and predicting the height to which a tsunami will rise along a coast. Actual measurements of height, speed, direction of propagation, or shape of the wave front on an open ocean are essential. High resolution optical photography or radar imagery, which would be developed for other observations, is suggested because of the infrequency of tsunamis. This earth-observing equipment could be triggered from the tsunami warning system whenever an undersea earthquake was detected. M.W.R.

N65-30353* Acadia Univ., Wolfville (Nova Scotia).
CURRENTS AND PHOTOGRAMMETRY
H. L. Cameron *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 29–36 refs Prepared jointly with AFCRL and DRB of Canada (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Stereo time lapse photography, which is used to measure the speeds of moving objects by stereo measurement of the false parallax produced by motion between photos, is considered for use in manned space platforms for the study of ocean currents. Both conventional aerial photography and radar scope photography are deemed feasible. The principle of time-lapse measurement of water currents by aerial photography is illustrated and stereophotos showing running current are included. M.W.R.

N65-30354* Air Force Cambridge Research Labs., Bedford, Mass.
OPTICS
John F. Cronin *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 37–38 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Visual observations from manned orbiters, photography from extreme altitude aircraft, visibility problems, and an unconventional photographic technique are mentioned. M.W.R.

N65-30355* California Univ., San Diego. Visibility Lab.
OCEANOGRAPHY FROM MANNED SATELLITES BY MEANS OF VISIBLE LIGHT
Seibert Q. Duntley *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 39–45 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Potentialities of oceanographic observations from manned satellites by means of visible light are discussed in terms of direct capabilities of the human observer and the photographic and electronic visual aids he might employ. An Apollo Orbital Research Laboratory is suggested as a possibility for conducting such studies. Atmospheric limitations, sea state determination, and chlorophyll assay are discussed. It is concluded that, with adequate preparation, many physical and biological features of the ocean can be observed through a manned orbital research laboratory. M.W.R.

N65-30356* Aracon Geophysics Co., Concord, Mass.
LIMITATIONS TO NIGHTTIME VISUAL OBSERVATIONS FROM SATELLITES
W. K. Widger, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 49–50 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

The observing ability of a satellite system is determined by the interference band effect of the airglow, the atmospheric

albedo, and the reflectance or emission of the viewed objects in contrast to the background. Minimum target illumination is governed by night illumination required to overcome the night airglow and the transmittance-reflectance losses in the scene. Since the average illumination at the satellite due to night airglow is about 10^{-4} foot-candles, it is assumed that useful meteorological information will be obtained. Minimum illumination required will be modified by auroral activity and latitude being observed. Filtering to eliminate the airglow lines is considered a questionable solution. M.W.R.

N65-30357* California Univ., San Diego. Scripps Inst. of Oceanography.

POSSIBLE OCEANOGRAPHIC AND RELATED OBSERVATIONS FROM SATELLITES

John D. Isaacs *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 51 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Suggestions are made regarding observations of optical phenomena, made from satellites, which would yield insight into meteorological events on the earth and other planets. Observations of the displacement of the specular image of the sun in ice clouds appear to be a direct measure of horizontal acceleration of the cloud and could provide a sounder basis for the study of planetary atmospheres from earth, earth satellite, and flyby. M.W.R.

N65-30358* Air Force Cambridge Research Labs., Bedford, Mass.

EXTRAORDINARY CLOUD PATTERN OVER BAY OF BENGAL

John F. Cronin and R. C. Wanta (Boston Coll.) *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 53–61 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

A crescent cloud pattern unique in size and shape which was observed off the east coast of India by TIROS photography is discussed. It was noticed that the crests of the cloud pattern quite closely approximate the third and fourth of four equally spaced crests originating from the computed epicenter, but the significance of these findings is considered problematical. Meteorological causal factors are hypothesized and considered weak because of the small intensity of the offshore wind relative to the large amplitude of the pattern. Therefore, upwelling and a combination of causes are among those factors considered. Whatever the causes, however, it is considered probable that the comparatively cloud-free sea surface within the area bounded by the pattern and the coast is colder than the adjacent waters, and at the convergent region along the interface of these water masses of differing temperatures the cloud crescent has formed. It is speculated that the length of the pattern made it unstable and open to some outside influence. Rarity of this pattern in TIROS films to date might be due to rarity of a rope of cloud 880 nautical miles or longer. M.W.R.

N65-30359* Air Force Cambridge Research Labs., Bedford, Mass.

UNCONVENTIONAL PHOTOGRAPHY AND OCEANOGRAPHY

John F. Cronin *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 63–72 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

High altitude and multispectral photography are considered for applications to marine biology, physical oceanography, and coastal processes. A nine-lens multiband camera, which provides photographic coverage in contiguous narrow bandwidths from 0.4 to 0.9 microns, is used for simultaneous exposure over this range. M.W.R.

N65-30360* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SPACE PHOTOGRAPHY: A REVIEW

Paul D. Lowman, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 73–89 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

History, present status, and capabilities of space photography are reviewed; and representative photographs and a summary of successful space photography flights are included. The main advantages of space photography over conventional aerial photography are listed as wider perspective, world-wide coverage, greater speed, and rapid repetition of coverage. Such characteristics make space photography potentially applicable to geologic reconnaissance, topographic mapping, and oceanography. Space photography, however, can only partially duplicate aerial photography in producing large scale pictures through the use of long focal-length cameras. M.W.R.

N65-30361* Michigan Univ., Ann Arbor. Inst. of Science and Technology.

ORBITAL SENSORS FOR OCEANOGRAPHY

M. R. Holter and R. R. Legault *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 91–109 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Coordinated simultaneous multispectral sensing in the infrared, visible, and ultraviolet bands is considered by using calibrated radiometers, relative spectrometers, and imaging sensors. Infrared scanning devices and existing results applicable to oceanographic problems as well as non-imaging radiometers for sensing ocean surface temperatures are discussed. Such techniques are considered applicable to orbital usage, and it is recommended that initial orbiting experiments be carried out in manned vehicles because of equipment setup aiming, and detector cooling operations. First, however, it is recommended that initial operations to establish optimum methods of application be limited to aircraft flying below 10000 feet because of difficulties associated with oxygen and special equipment for the crew. M.W.R.

N65-30362* Tiburon Marine Lab., Bureau of Sport Fisheries and Wildlife, Calif.

AIRBORNE OCEANOGRAPHIC PROGRAMS OF THE TIBURON MARINE LABORATORY AND SOME OBSERVATIONS ON FUTURE DEVELOPMENT AND USES OF THIS TECHNIQUE

James L. Squire, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 119–123 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Two synoptic oceangraphic programs utilizing low altitude aircraft are being conducted to determine infrared radiation from the sea surface and to monitor the distribution and abundance of pelagic schooling species. Three U.S. Pacific coastal areas are being surveyed with an airborne infrared thermometer with a field view of about 686.4 sq ft at an elevation of 500 ft to provide detailed pictures of the surfaces isotherms on the continental shelf and to determine how oceanic environment influences the distribution of fishery resources. The pelagic fish monitoring program employs dickside catch statistics and low elevation flight operations at night during the absence of moonlight. Observations and research suggestions are noted relating to future uses of manned high altitude aircraft and manned or unmanned satellites in the field of biological oceanography. M.W.R.

N65-30363* Fleet Numerical Weather Facility, Monterey, Calif.

OPERATIONAL ANALYSES AND FORECASTING OF OCEAN TEMPERATURE STRUCTURE

Paul M. Wolff *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 125–147 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Factors affecting the thermal structure of the ocean and sources of errors in surface temperature reports are reviewed. The heat budget of the interaction between oceans and atmosphere has been adapted to numerical computations, and the dependence of the oceanic temperature structure on atmospheric events is demonstrated. Effects of constraints of grid mesh size and instrument and transmission errors are considered for sea surface temperature analyses; and underwater temperature structure is analyzed. A two day prediction is obtained by applying the integrated effects of the calculated energy exchange at the surface. Examples of thermal structure analyses are presented, numerous charts and tables are included, and the accuracy of measurements at sea is summarized. M.W.R.

N65-30364* Fleet Numerical Weather Facility, Monterey, Calif.

FUTURE USE OF SHIPS, BUOYS, AIRPLANES AND SATELLITES IN OBTAINING OCEANOGRAPHIC OBSERVATIONS FOR ENVIRONMENTAL PREDICTION SYSTEMS

Paul M. Wolff *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 149–150 (See N65-30350 19-13) CSTI: HC $7.45/MF $2.25

The general philosophy of the Fleet Numerical Weather Facility concerning gathering of environmental data both in the atmosphere and the oceans is outlined, and present shortcomings in observational data are discussed. Use of different platforms in obtaining synoptic oceanographic data is considered. M.W.R.

N65-30365* Woods Hole Oceanographic Institution, Mass.

OCEANOGRAPHIC FORECASTING

Columbus O'd. Iselin *In its* Oceanog. from Space Apr. 1965 p 151 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Principal needs for present-time oceanographic forecasting are for precise low level wind information, especially in summer, and for means of mapping sharp horizontal thermal gradients at the surface. While present needs are confined to the northern hemisphere it is suggested that worldwide oceanographic forecasts will make a mjaor contribution to weather forecasting over land areas. Principal practical objects of oceanographic forecasts are for ship routing, fisheries management, and horizontal sound transmission. M.W.R.

N65-30366* Pacific Oceanographic Group, Manaimo (British Columbia).

THE POSSIBLE USE OF SATELLITE DATA IN ESTIMATING THE DEPTH OF THE THERMOCLINE

John P. Tully *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 153–157 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

The use of satellite data in conjunction with existing data or techniques now under development is considered for possible use in estimating the depth of the thermocline. The role of satellites in oceanography, sea surface temperature determination, weather assessment, and communications is discussed. It is considered practical to use drifting sensing buoys, located and monitored by polar orbiting satellites, in any part of the world ocean in spite of limitations of communications facilities. M.W.R.

N65-30367* Naval Oceanographic Office, Washington, D. C.

RELATION OF THERMOCLINE DEPTH TO SURFACE TEMPERATURE IN THE ATLANTIC

John J. Schule, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 159–165 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Several experiments have been conducted to compare airborne radiation thermometer measurements with surface observations taken by other means. One experiment is illustrated and its flight track shown; contours of sea surface temperature were used to compare temperatures along the flight track with actual airborne radiation thermometer readings. Success with this thermometer suggests its possibility of obtaining similar data from satellites. The relationship of thermocline depth to surface temperature in the northwestern Atlantic Ocean is under investigation. M.W.R.

N65-30368* Columbia Univ., New York. Lamont Geological Obs.

OCEANOGRAPHIC PROBLEMS OF UTILIZATION OF SATELLITES

Takashi Ichiye *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 169–173 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Direct measurements and buoy systems are considered in the utilization of satellites for solving oceanographic problems and the use of buoys for worldwide measurements of internal waves and for studying eddies of geostrophic scales is discussed. Main purposes of the buoy system for measurement of internal waves of tidal periods are to study their causes, frequency, occurrence and modes of propagation, relationships with surface tides, and interaction with the general circulation of the oceans. A synoptic measurement of the development of eddies of geostrophic scale can be made with either ships or buoy systems. Methods of closely spaced buoys must be maintained for a long period of time, and a means of determining the most effective spacing for detection of eddies with the minimum number of eddies is considered. M.W.R.

N65-30370* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INTRODUCTORY REMARKS ON INFRARED SENSING

R. J. P. Lyon *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 179–180 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

It is emphasized that Scientists are now able to study in detail narrow wavelength bands in the infrared spectrum and that radiometers respond to radiant energy received. Radiant emission is a function of the temperature of the source, an efficiency factor or emittance, and a constant factor designated as "k". In the case of water, in a steady flat sea state at near normal incidence and in the 8 to 12 micron band, a factor of 0.98 may be used if the emittance is not known. Waves and whitecaps markedly change this value. It is pointed out that while thermal contrast maps may be readily prepared by thermal scanning and image-producing units, these maps are essentially radiance contrast maps and may be maps of sea state rather than true temperature differences. M.W.R.

N65-30371* Texas Instruments, Inc., Dallas.

OCEANOGRAPHIC USES FOR AN AIRBORNE INFRARED DETECTION DEVICE

Richard A. Geyer *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 183–187 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

High mobility and day and night utility make an airborne infrared detection device useful for synoptic oceanographic observations. Several limiting constraints are the resolving power of the optical system that forms the image for

the scanning system, the minimum radiometric temperature differential that the infrared part of the system can sense, and the amount of cloud cover and other meteorological conditions. Nonetheless, this device could be used to take an infrared look at the world's oceans and to directly measure parameters in the surface layer. Information collected could be used to revise surface temperature charts, determine annual variation and chart diurnal variations in surface temperatures of the ocean, or determine if there is a seasonal repetition of isotherms on an ocean-wide basis. Data might be used to track large water masses, study major surface ocean currents, discover areas of upwelling, or study small-scale convective activity occurring in the thermocline. A region of unusual surface radioactivity might be found with an infrared sensing device which appears to have general applicability in problems concerning the heat budget of the world's oceans. M.W.R.

N65-30372* California Univ., San Diego. Scripps Inst. of Oceanography.

OCEANOGRAPHIC MEASUREMENTS WITH AIRBORNE INFRARED EQUIPMENT AND THEIR LIMITATIONS. A TWO-WAVELENGTH MICROWAVE RADIOMETER FOR TEMPERATURE AND HEAT EXCHANGE MEASUREMENTS AT THE SEA SURFACE OF POSSIBLE USE IN MANNED SATELLITES

E. D. Mc Alister and W. L. Mc Leish *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 189–214 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

The construction of a two-wavelength microwave radiometer that can make temperature and heat exchange sea surface measurements through heavy overcasts has been shown to be theoretically possible. Infrared scanner records with interpretations, direct radiometer measurement of the total heat flow from the sea surface, heat exchange and radiance from the sea surface at night, oceanographic and meteorological value of direct measurement of total heat loss at the sea-air interface, and weather and atmospheric absorption limitations on infrared radiometry are discussed. Reflectivity and emissivity of sea water in the short microwave region and microwaves with optical depths $\frac{1}{k}$ in water of one millimeter or less, and other aspects of microwaves are considered. M.W.R.

N65-30373* Coast and Geodetic Survey, Washington, D. C.

BRIEF FOR CONFERENCE ON OCEANOGRAPHIC EXPLORATION FROM SATELLITES

Alber Oshiver *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 217–218 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Sea surface observations from satellites are considered in terms of applications to radiometry, currents, bottom topography, sea level and gravity, and geomagnetism. Numerous current and proposed applications within these categories are mentioned. M.W.R.

N65-30374* Aracow Geophysics Co., Concord, Mass.

THE APPLICABILITY OF TIROS AND NIMBUS DATA TO INVESTIGATION OF THE FEASIBILITY OF SEA SURFACE TEMPERATURE MEASUREMENTS FROM SATELLITES

Arnold H. Glaser, Earl S. Merritt, Raymond Wexler, and William K. Widger, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 219–227 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Requirements for improved sea surface temperature data, applicability of satellite observations, atmospheric modifications and degradations of surface infrared emission, and applicability of Nimbus high resolution infrared radiometer (HRIR) data to sea surface temperature observations are discussed. Foreseeable improvements in satellite sensors pertinent to sea surface temperature determination are mentioned and data processing and analysis are considered. The latter includes discussions on data formats and computer programs; geographical location, rectification, and scale of resolution; detection and correction for atmospheric effects on satellite-observed surface temperatures; consideration of cloud interference and elimination of data with clouds; data processing to eliminate data points subject to cloud interference; and consideration and correction of atmospheric absorption and emission. M.W.R.

N65-30375* Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

MICROWAVE SPECTRAL MEASUREMENTS APPLICABLE TO OCEANOGRAPHY

David H. Staelin *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 229–234 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Interactions between the sea and the atmosphere with microwave radiations have spectral characteristics which are discussed and graphed in terms of the microwave brightness temperature observed above the atmosphere over a smooth sea. Predicted brightness temperature spectra are compared with temperature sensitivities of currently available radiometers. The spectral region considered, extending from 10cm to 6cm, is most pertinent to oceanographic problems because it is least affected by the ionosphere and by atmospheric absorption. Both tunnel diode amplifiers and parametric amplifiers are sufficiently sensitive to detect the spectral features. Superheterodyne radiometers are considered the best available systems for use at higher frequencies in the spectrum; their bandwidths make them suitable for narrow spectral features. At the present time other radiometric systems employing traveling wave amplifiers or masers are not considered as practical for spacecraft as those systems discussed. M.W.R.

N65-30376* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MICROWAVE RADIOMETRY AND APPLICATION TO OCEANOGRAPHY

F. T. Barath *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 235–239 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

In order to extract the desired parameter for microwave brightness temperature as measured by radiometers, it is necessary to minimize the effects of thermometric temperature, emissivity/reflectivity, physical state of the ocean surface, penetration effect of wavelength, attenuation and radiation effects of the intervening medium, and polarization. Microwave radiometers are considered extremely well suited to determine ice formations due to the very high emissivity of ice compared to sea water, and precise ice area maps could be obtained from aircraft or satellite altitudes under any weather conditions. It is also possible to determine the thermometric temperature of the top layers of the seas, sea state, and thickness of ice over water by the use of two or multi-frequency radiometers. Distribution of water vapor and condensed water above the ocean as well as atmospheric temperature profiles could be obtained in the same way. M.W.R.

N65-30377* Space General Corp., El Monte, Calif.

MICROWAVE RADIOMETERS FOR OCEAN AND WEATHER MEASUREMENTS. PART I: SUMMARY DISCUSSION OF MICROWAVE RADIOMETRY

William H. Conway and Austin Mardon *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 241–271 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Applications of microwave radiometry to ocean and weather problems were investigated with regard to ice, snow, and water coverage of land masses; sea ice coverage; snow pack depth and moisture content; atmospheric temperature and humidity profiles; and sea state characteristics. A generalized equation for the apparent radiometric temperature of sea water is given, and a plot of apparent zenith sky temperature as a function of frequency is thereby calculated. Generalizations are made regarding the determination of sea temperature, sea swells, fog column, and water vapor column. Emissivity of multilayer specular surfaces and effect of rain on apparent sky temperatures are discussed. Radiometers are considered in terms of laboratory, airborne, and space applications and a summary discussion of microwave radiometry is included. M.W.R.

N65-30378* Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
OCEANOGRAPHIC APPLICATIONS FOR RADAR
Bernard B. Scheps *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 273–285 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Unclassified state-of-the-art in side-looking radar imaging is discussed and oceanographic applications are suggested. Photos with a Ku band radar show a large tear fault, a transition area from steep slopes and thin soils to deeper soils, differentiation of structures, rock classes and drainage, and periodic wave-form in the water offshore and in the estuaries. Examples are given of what may be done if there is sufficient knowledge of ground conditions to permit quantitative analyses, and an analysed radar image is shown. Details are given for the mechanics involved in this type of photography, which appears to have the greatest applicability in the study of shore and estuarine morphology. Other applications are discussed. M.W.R.

N65-30379* Woods Hole Oceanographic Institution, Mass.
RECOMMENDATIONS OF THE PANEL ON MARINE METEOROLOGY
In its Oceanog. from Space Apr. 1965 p 289–290 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Present-day techniques for remote sensing and probing are considered promising for studies from ships, towers, or airplanes, but the capabilities in the infrared and microwave ranges appear to be marginal as far as surface observations from satellites. An extensive development effort is warranted for the latter because of its potential value in heat flux measurements and stress estimates. Other obvious possibilities are the estimating of radiative energy balance by photographic deductions of cloud cover and infrared estimates of water vapor in the atmospheric column. M.W.R.

N65-30380* Aracon Geophysics Co., Concord, Mass.
THE ROLE OF SATELLITE AND MANNED SPACECRAFT IN MARINE METEOROLOGY
Earl S. Merritt *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 291–293 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Areas where meso-scale or synoptic scale meteorological observations are considered useful include surface wind generation; wind effect on ocean currents; temperature variations related to evaporation, cloud cover, and short-term local effects of precipitation; pressure and wind effects on tidal enhancement; sea ice drift, erosion, and formation of pressure ridges in polar region ice fields; effect of wind-driven ocean waves on coastlines and beaches; and the interactions between wind-driven waves, currents, and winds which effect ship routings and other marine operations. Observations from TIROS satellites and manned spacecraft give data for examining specific synoptic scale problems, and, along with Nimbus and other satellite data, provide material for systems design and for training the astronauts who will make observations in the future. While man's observational role is considered unclear, it is stated that he requires far greater logistic support than an unmanned satellite. M.W.R.

N65-30383* Harvard Univ., Cambridge, Mass.
TRANSPARENCY, BIOLUMINESCENCE AND PLANKTON
George L. Clarke *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 317–319 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

A summary of conditions of light in the sea, especially as related to biological phenomena, is presented to serve as a basis for considering studies to be made from high-flying craft. Information on transparency, reflection, and scattering in the sea and intensity, frequency, and duration of flashing produced by luminescent organisms can be used for the design of instruments which will respond to light reflected from or emitted by living organisms. It should be possible to map the occurrence of bioluminescence and the positions of large objects rapidly over great areas and to considerable depths. M.W.R.

N65-30384* California Univ., San Diego, Calif. Scripps Inst. of Oceanography.
DETECTION OF MARINE ORGANISMS BY AN INFRARED MAPPER
T. J. Walker *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 321–335 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Infrared mapping devices can detect whales and fish which are near enough to the surface to generate gravity waves or turbulent eddies. Infrared detection of marine organisms requires the surface of the water to be either warmer or colder than the layer just below. The existing system as operated from moving aircraft functions best at 1000 feet, and this altitude permits resolution of at least the larger biological targets. M.W.R.

N65-30385* Acadia Univ., Wolfville (Nova Scotia).
RADAR AND ICE SURVEYS
H. L. Cameron *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 341–350 ref Prepared jointly with AFCRL and DRB of Canada (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

High resolution radar from altitudes of 40 000 feet can make accurate ice cover surveys in Arctic and sub-Arctic areas at reasonable cost. Time lapse photography and successive covers should be able to determine the speed of and plot the seasonal pattern of ice field movements. Such radar sensors have the advantage of all-weather and all-season capability, and should, therefore, be considered for any projected oceanographic, earth science, or manned orbital laboratory. In its present form, radar can be applied with existing aircraft to extensive polar studies. M.W.R.

N65-30386* Kansas Univ., Lawrence. Center for Research in Engineering Science.
SATELLITE RADAR AND OCEANOGRAPHY, AN INTRODUCTION
Richard K. Moore *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 355–366 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Technically feasible radars that can be used as remote sensors when flown in satellites are related to oceanography. A geometric description of radar return principles is included to define and identify appropriate parameters. Radar parameters that may be separately adjusted in any experiment and the surface parameters that may cause differences in the radar response of earth, sea, or cloud are considered; and the basic radar equation is developed. Properties of scattering cross section, which is a function of many conditions of the use of the radar as a sensor, are considered, and an observed scattering angle is illustrated. Various types of radar displays are discussed and illustrated, and two remote sensing experiments using radars in satellites are mentioned. One experiment uses a 10-pound package on an unmanned satellite and is basically an altimeter; the other is a much larger package for use in a manned orbital research laboratory. M.W.R.

N65-30387* Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
RADAR BACKSCATTERING FROM THE SEA
Isadore Katz *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 367–376 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Radar reflectivity of the ocean surface depends on the structure of the surface as well as the wavelength and polarization of the electromagnetic energy transmitted. Ocean surface roughness could be determined by using satellite-borne radar to measure radar cross section as a function of depression angle. Sea clutter, which is a dimensionless measure of the reflective property of the surface and is dependent upon depression angle, polarization, sea roughness, and radar orientation with respect to sea, is discussed. Scattering versus roughness, polarization, wind direction, and electromagnetic wavelength are considered. An experimental program to study radar reflectivity and a possible radar for a manned spaceship, with parameters, are included. M.W.R.

N65-30388* Oceanics, Inc., Plainview, N. Y.
THE APPLICATION OF AIRBORNE RADAR BACKSCATTER TO MEASUREMENT OF THE STATE OF THE SEA
Wilbur Marks *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 377–391 refs Submitted for Publication (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25 (Contract Nonr-3961(00))

Use of airborne radar backscatter from the sea surface as a measure of waves present is considered. Wave profiles from stereophotographs obtained on a ship are converted to radar statistics, and a typical recording of radar backscatter is included. The wave statistics correlate well with both radar backscatter and model tank data. Radar observations tend to confirm the positive nature of the upwind-downwind ratios calculated from wave profiles. The negative ratios are confirmed by optical experiments in the model tank. It appears that horizontal polarization results correlate better with calculations than do results from vertical polarization. For the particular sea state condition considered, the ratio of effective radar backscattering areas in the upwind and downwind directions is related to radar return observed by aircraft. Whether this relationship is unique with regard to change in sea state is a question for exploration. At the present time profiles are being prepared for a sea of 2 to 2.5 feet. M.W.R.

N65-30389* New York Univ., N. Y.
WINDWAVES AND SWELL
Willard J. Pierson, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 393–402 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Satellites can be used to survey the whole world ocean on a synoptic scale from day to day, and the obtained data can serve as an initial input in the forecasting of wave action. Waves generated by the action of wind on the water can be interpreted by a combination of physical and probabilistic concepts, and an equation for deriving the significant height of a wave is derived by the latter concept. Measured ocean waves can be converted into a spectral estimate by techniques due to time series methods and statistical concepts. Wave forecasting and use of satellites are discussed, and numerous applicable charts and graphs are included. M.W.R.

N65-30391* Institute of Naval Studies, Cambridge, Mass.
MICROWAVE REFLECTIVITY MEASUREMENTS
Hanns J. Wetzstein *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 411 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

A suggestion is offered with regard to the use of active microwave reflectivity measurements as an indirect way of measuring sea surface temperature. This may offer resolution and penetration advantages if the radiometer optics can be made large enough. The use of synthetic aperature techniques may help with resolution and a low altitude aircraft illuminator is suggested for the power requirements in certain regions. M.W.R.

N65-30392* Office of Naval Research, Washington, D. C.
USE OF ORBITING RESEARCH LABORATORIES FOR EXPERIMENTS IN COASTAL GEOGRAPHY
Evelyn L. Pruitt *In* Woods Hole Oceonog. Inst. Oceanog. from Space Apr. 1965 p 419–421 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Orbiting research laboratories could obtain synoptic coverage of coastal areas throughout the zone of orbit as well as repeated detailed coverage of particular coasts. Experiments could explore, and possibly solve, basic problems of time-scale and spatial-scale of nearshore and coastal phenomena to provide sampling system guides for other problems. Suggested experiments in the field of coastal geography deal with environments of shore, shelf, and basin zones; nearshore circulation and sedimentation; submerged bars in or near the surf zone; mineral composition of beaches; the origin of the Carolina bays; tidal streams; and regional structure and lithology. M.W.R.

N65-30393* California Univ., San Diego. Scripps Inst. of Oceanography.
STUDY OF RIVER EFFLUENTS FROM SPACE VEHICLES
Fred B. Phleger *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 425–426 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Quantitative estimates of total fresh water supply and sedimentation can be made by mapping the surface area of a river effluent from an aircraft or space vehicle equipped with photographic and temperature sensing instruments. First, the exact shape of the wedge of river water is determined; then, the volume of fresh water and quantity of sedimentation in suspension is estimated by depth surveys of water salinities and direct measurement of sediment concentration. These results can be used to estimate fresh water supply and sedimentation, and provide information concerning runoff from rivers, both of which have worldwide implications. In order to conduct representative studies, it is suggested that river effluents be divided into small classes according to total flow; ephemeral or perennial flow; wind, wave, tidal, current, and ice conditions at the effluent; sediment load; and size and shape of the effluent. Close correlation of ground analysis and airborne surveillance will be required to accomplish such a study, which also can shed light on floods and hurricanes and deposition in deltas. M.W.R.

N65-30394* Florida Univ., Gainesville. Dept. of Coastal Engineering.
POSSIBILITIES FOR USE OF SPACE AND OTHER HIGH ALTITUDE VEHICLES FOR GATHERING OF COASTAL ENGINEERING DATA
Per Bruun *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 429–431 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Radar, stereophotography, and infrared photography are considered to offer excellent opportunities for coastal engineering research. Meteorological data for the prediction of waves and hurricane structure, information on tidal and longshore currents caused by wavebreaking, studies on sediment transport caused by the action of waves and currents on alluvial shores, and surveys on coastal topography and morphology could be made by space and other high altitude vehicles.
M.W.R.

N65-30395* Columbia Univ., New York.
COASTAL PROCESSES
Rhodes W. Fairbridge *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 433–434 (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Coastal processes are closely related to such phenomena as gravity waves, currents, tides, and runoff from rivers, as well as to long-term catastrophic meteorological and oceanographic events. Large-scale projects are needed to provide much-needed information about these phenomena. Airborne sensing programs must be coordinated with ground studies, and an overall planning and coordination committee with representatives from all interested government agencies and study groups should be established.
M.W.R.

N65-30396* Universidad Nacional Autonoma de Mexico, Villa Obregon. Instituto de Geologia.
STATUS OF MARINE GEOLOGY STUDIES IN MEXICO
Guillermo P. Salas and Agustin Ayala Castanares *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 435–454 refs (See N65-30350 19-13) CFSTI: HC $7.45/MF $2.25

Marine geological studies during the past six years are reviewed, an historical background of related information is presented, and an annotated bibliography of pertinent literature is included. Specific regional areas under study are discussed.
M.W.R.

N65-30414 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF DYNAMIC STRESS-FIELD IN SOFT EARTH, DURING CONTACT EXPLOSION
V. D. Alekseyenko *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 149–163 refs (See N65-30400 19-23)

The nonstationary stress field created by a ground surface explosion was investigated for medium granular sand. Energy distribution between the ground surface and the atmosphere and pressure distributions as function of distance from the point of detonation are discussed. Further, the blast wave propagation in the soil is considered.
E.E.B.

N65-30510# Smithsonian Astrophysical Observatory, Cambridge, Mass.
HIGH ALTITUDE WIND MEASUREMENTS BY COLLECTING AND PROCESSING METEOR RADAR ECHOES Scientific Report No. 1
Mario D. Grossi 13 Apr. 1965 21 p refs Presented at an Illinois Univ. Conf., Urbana, Ill., 21–23 Oct. 1963 *Its* Aeronomy Rept.-1
(Contract AF 19(628)-3248)
(AFCRL-65-362; AD-466318)

A system study is reported of a multistatic phase-coherent VHF radar capable of collecting meteor echoes from a volume in the upper atmosphere measuring approximately 30 km by 50 km horizontally and 16 km vertically, with the vertical dimension extending from 80 to 96 km above ground level, and with 240 resolvable cells. The basic measurements provide the radial components of the true wind velocities, and are expected to be obtained at a rate of 4000 samples/hr from the doppler shift of the echoes. By processing the collected information in a high-speed digital computer, quasi-real-time 2-dimensional and 3-dimensional wind velocity determinations are expected to be calculated at a rate of 100 determinations/hr and 2 determinations/hr, respectively.
Author

N65-30540*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry.
CHEMILUMINESCENT REACTION PROCESSES PERTINENT TO THE CHEMOSPHERE IN THE MICRON PRESSURE REGION
P. Harteck, R. R. Reeves, and D. Applebaum Jan. 1965 11 p refs
(Grant NGR-33-018-016; Contract AF 19(628)-4068)
(NASA-CR-64235) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Some atom reactions which result in light emission have been studied in a vacuum system operating in the 5 to 30 micron pressure region. At these low pressures two body reaction processes may dominate in certain cases as was shown previously for the nitric oxide–oxygen atom reaction and the sulfur monoxide–oxygen atom reaction. The visible chemiluminescent recombination reaction of nitrogen atoms at low pressures approaches second order which can be attributed to an inverse predissociation process. A tentative mechanism can be given as:

$$N + N \rightleftharpoons N_2\ {}^5\Sigma_g^+ \rightleftharpoons N_2B^3\Pi_g \rightarrow N_2A\ {}^3\Sigma_u^+ + h\nu,$$

where the rate for the light emission is estimated as $k = 10^{-19\pm1}$ (cm^3/particles) sec^{-1}.
Author

N65-30556# Army Engineer Nuclear Cratering Group, Livermore, Calif.
STUDIES OF THE PRE-BUGGY II APPARENT CRATERS Final Report, Jun.–Aug. 1963
Joseph L. Spruill and Fred F. Videon Jun. 1965 133 p refs
(Proj. Pre-Buggy II)
(PNE-315-F; AD-617884) CFSTI: $1.50

Charges were detonated in alluvial material at depths 16 and 32% deeper than optimum for radius for single charges. The resulting craters showed that when the charges are spaced one single charge crater radius apart, the row crater averaged 10% wider and 20% deeper than a crater from a single charge of the same weight detonated at the same depth. At wider charge spacings the row charge crater is both narrower and shallower. For a detonation depth 16% deeper than optimum for radius, the greatest volume per charge is excavated when the spacing is 1.125 single charge crater radii. The side row crater lips averaged 2.4 times the average lip height of single charge craters. However, the end row crater lips were smaller than those of the single charge crater and were irregular in vertical section. Side row crater lip height increases with detonation depth.
R.N.A.

N65-30560*# Alaska Univ., College. Geophysical Inst.
HIGH LATITUDE GEOPHYSICAL DATA, OCT.–DEC., 1964
V. P. Hessler, ed. Dec. 1964 81 p
(Contract NAS5-3595)
(NASA-CR-64261; UAG-C-38) CFSTI: HC $3.00/MF $0.75 CSCL 04A

High latitude geophysical data in graphical and tabular form are presented and include 30 Mc/s cosmic noise records, N-S telluric current records, N-S telluric amplitude activity, telluric fluctuation activity, telluric micropulsation activity, and geomagnetic activity. R.N.A.

N65-30621# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE 1 IONOSPHERIC DATA: ALOSYN, 16–31 JULY 1963
15 Feb. 1965 175 p

Topside sounder synoptic telemetry data, consisting of selected ionospheric parameters obtained from Alouette 1 ionograms, are presented in tabular form. C.T.C.

N65-30626# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
ADSORPTION AND FRICTION BEHAVIOR OF MINERALS IN VACUUM Research in Earth Physics Phase Report No. 2
Leslie G. Bromwell Mar. 1965 96 p refs
(Contract DA-22-079-ENG-330; ARPA Order 400)
(R64-42; AD-616737)

This report presents theoretical considerations on the adsorption and friction behavior of soils under high vacuum and extreme temperature conditions. It includes an extensive literature survey, particularly in the fields of surface chemistry and physics, adsorption, and friction. The importance of using clean, reproducible surfaces for surface studies is demonstrated. The necessity of clean ultrahigh vacuum test conditions for producing and maintaining clean surfaces is emphasized. The relationship between atomic forces and surface energy and the friction and adhesion between solid surfaces is discussed. A theoretical relationship between adsorption energy and the temperature and pressure required to remove adsorbed layers is derived. The frictional behavior of quartz is considered in detail. Author

N65-30641# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE I IONOSPHERIC DATA N(h), VOLUME 2, NUMBER 2
15 Feb. 1965 312 p

Tabulations are presented on electron number density profiles for selected groups of ionograms obtained from the Alouette I topside sounder satellite. R.N.A.

N65-30732*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND VELOCITY PROFILES MEASURED BY THE SMOKE-TRAIL METHOD AT WALLOPS ISLAND, VIRGINIA, 1959 TO 1962
Robert W. Miller, Robert M. Henry, and Mickey G. Rowe Washington, NASA, Aug. 1965 64 p refs
(NASA-TN-D-2937) CFSTI: HC $3.00/MF $0.75 CSCL 04A

Twenty-three detailed wind profiles measured by the smoke-trail technique are presented as plots of west-to-east and south-to-north velocity components at height intervals of 25 meters. The altitude ranges of individual profiles vary, but the overall range is roughly 2 to 20 kilometers. The measurements were made under a wide variety of weather conditions, including one case with an exceptionally high maximum wind. Modifications of the measurement technique and accuracy of the profiles are discussed. Author

N65-30733*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SURVEY OF THE METHODS DEVELOPED FOR THE INVERSION OF THE RADIATIVE TRANSFER PROBLEM FOR PLANETARY ATMOSPHERES
Barney J. Conrath Washington, NASA, Aug. 1965 19 p refs
(NASA-TN-D-2940) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Five of the methods developed for obtaining the thermal profile of a planetary atmosphere from remote radiometric measurements are discussed and compared. An extension of the "variable slab" method of King is used in making an inversion calculation for a model atmosphere. The question of the stability of the solutions of the basic integral equation of the problem and its implications on the accuracy of the derived temperature profile are considered. It appears that some smoothing will have to be introduced, regardless of the method used, in order to achieve a stable solution from a given set of observational data containing random errors. A considerable amount of work remains to be done, including extension of the variable slab method to arbitrary band transmissions and the performance of detailed error analyses of the various inversion methods. It also seems desirable to examine the problem from the point of view of the uses to be made of the derived thermal structure in order to ascertain whether the smoothed solutions retain sufficient physical information to be of value. Author

N65-30738# California Univ., Berkeley. Dept. of Geology and Geophysics.
DIGITAL COMPUTER PROGRAMS FOR PALEOMAGNETIC RESEARCH. PART I Final Report, Jul. 1963–Dec. 1964
C. S. Grommé [1965] 60 p refs
(Contract AF 19(628)-2386)
(AFCRL-65-83(I); AD-616358)

This report describes three programs written in Fortran IV for the IBM 7090 and 7094 digital computers. Their purpose is reduction and statistical analysis of remanent magnetization data obtained from oriented rock specimens used in paleomagnetic research. The first program computes, for each oriented specimen, the declination, inclination, and intensity of remanent magnetization, using as input the component directions and intensities obtained with an induction ("spinner") magnetometer. An estimate of the precision of angular measurement is also obtained, and in the case of deformed rocks, the magnetization is obtained both in present geographic coordinates and in what may be surmised to have been the original coordinates. The second program uses the output from the first and calculates the mean magnetization directions of groups of specimens, the appropriate statistical parameters, and the paleomagnetic pole position corresponding to each group. The third program calculates the mean poles from groups of paleomagnetic poles, together with the appropriate statistics for each. Author

N65-30802# Lightning and Transients Research Inst., Minneapolis, Minn.
TRIGGERED LIGHTNING DISCHARGES AND APPLICATION TO V.L.F. PROPAGATION STUDIES Final Report, Part I
M. M. Newman Oct. 1964 23 p refs
(Contract AF 19(604)-7984)
(L&T-417; AFCRL-64-859(I); AD-616550)

Natural lightning discharge observations in VLF propagation studies would be greatly helped by direct measurements of the lightning discharge currents corresponding to received wave shapes at various locations. Consequently a technique for triggering, recording and identifying natural lightning discharges has been evolved by rocket-launching a conducting wire into

charged thunderstorm clouds, and superposing a 1000 megawatt peak radiated power "signature" pulse. Thunderstorm areas of greatest overhead charge intensity were followed by monitoring gradient variations at sea, with an initial frequency of triggering of two discharges brought down out of five rocket firings of 1000 ft wires. Corona current measurements on the wire on the way up indicated negligible disturbance of the cloud charge before the actual lightning stroke was triggered. The triggering wire was vaporized but the consequent lightning discharge current continued to flow along the path of the wire through current measuring shunts which provided accurate oscillographic recording of the lightning discharge current wave shape. Author

N65-30808# Columbia Univ., New York.
SELECTED GREAT BASIN PLAYA CLAYS Scientific Report No. 4
Necip Güven and Paul F. Kerr Bedford, Mass., AFCRL, Feb. 1965 40 p refs
(Contract AF 19(604)8387)
(AFCRL-65-131; AD-617554)

Mineralogical studies of samples from Deep Springs Playa, Calif., Mud Lake and Humboldt Playa, Nevada, Sevier Playa, Utah and the Animas Playa, New Mex., indicate that the mica-type clay minerals illilte, vermiculite, and montmorillonite are prominent in these playa crusts. These widely separated localities suggest a general distribution. The weathering of the mica-type layer silicates results in the development of intensive heterogeneity of lattice layers along the c-direction. The continuous scattering in the lower angle region $2\Theta = 4-8.8°$ shows gradual transitions between mica-type layers with different basal spacings. Further, there is an intensive disorder in a-b planes of many layers, i.e., random displacements of the layers causing 'continuous scattering' accompanying the normal Bragg reflections. The b-dimensions and the high $MgO+FeO+Fe_2O_3$ contents of the mica-type layers indicate their derivation from tetrasilicic members of the dioctahedral mica-type layers. Author

N65-30817# Kiruna Geophysical Observatory (Sweden).
AURORAL ZONE IONOSPHERIC RESEARCH Annual Summary Report, 1 Mar. 1964–28 Feb. 1965
Ludwik Liszka and Svante Westerlund 24 Mar. 1965 28 p refs
(Contract AF 61(052)-678)
(AFCRL-65-330; AD-616841)

A large number of satellite records (satellites 1961 omicron 1, 1963-49C and 1964-64A (S-66)) were investigated with emphasis on scintillation phenomenon and Faraday rotation. The scintillation-rate spectrum of satellite signals at 54 Mc/s observed at Kiruna was studied. Temporal variations in the scintilation-rate spectrum, in particular the occurrence of slow and fast scintillation was investigated. The height of scintillation-producing irregularities was studied. Measurements made at Kiruna were even compared with those made at Tromsö, Norway. A new method for measuring of velocity of the diffraction pattern on the ground was also proposed. Irregularities of Faraday rotation were studied using satellite records made at seven European observatories. The correlation of the amplitude of the irregularities at different locations at the same time, and the correlation with other geophysical parameters was examined. Some new results on the horizontal gradients of electron content in the polar regions were obtained. The ionospheric electron content near the auroral zone was even investigated using differential Faraday observations of the multifrequency beacon satellite S-66 (1964-64A). Author

N65-30820# Lincoln Lab., Mass. Inst. of Tech., Lexington.
IONOSPHERIC BACKSCATTER OBSERVATIONS AT MILLSTONE HILL
John V. Evans 22 Jan. 1965 77 p refs *Its* Tech. Rept. 374
(Contract AF 19(628)-500)
(ESD-TDR-65-34; AD-616607)

Studies of the electron-density, electron and ion temperatures in the F-region were made by means of ground-based radar observations. A 70-meter parabolic antenna directed vertically and a 2.5-Mw pulse radar operating at 440 Mcps were employed for these measurements. Examination of the echo power as a function of height leads to a profile of electron density with height, provided the electron and ion temperatures are the same ($T_e = T_i$). Additional measurements of the spectra of the signals corresponding to different heights permit the ratio T_e/T_i to be determined and, where this is different from unity, the observed profile can then be corrected for the effect on the scattering introduced by the inequality in temperature. The ratio T_e/T_i achieved a maximum value ~2.0 to 2.6 at a height of about 300 km soon after dawn, irrespective of the season. There was little change in height dependence in this ratio throughout the daylight hours, and at sunset the ratio fell with a time constant of the order of an hour. At night T_e/T_i was occasionally close to unity, but more often a significant difference remained in the temperatures at all heights. Ion temperature increased with height at all times, but above 500 km this may be due in part to the presence of an unknown amount of He^+ ions, which considerably affects the interpretation of the signal spectra. Author

N65-30878# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FREQUENCY DEPENDENCE OF IONOSPHERIC ABSORPTION
Julio Edgardo Barety (M.S. Thesis) Jun. 1965 186 p refs
(SP/PH65-1; AD-616709)

The magneto-ionic theory is examined in its relation to absorption calculations. For representative profiles the complex index of refraction was computed using the Appleton-Hartree and Sen–Wyller magneto-ionic formulas. The height profiles of the real and imaginary part of the index of refraction are plotted and the absorption corresponding to day-time and night-time conditions is computed and its frequency dependence determined. It is determined that absorption for general conditions also follows closely an inverse square law, although there are deviations, particularly for the extraordinary ray. It is determined that general propagation conditions do not affect radically the possible use of differential absorption for total absorption measurements. A possible method for doing this is given. The variation of the absorption coefficient as a function of parameter N is also determined and the linearity condition $\kappa = K(\nu,\omega)N$ is shown to hold under certain conditions for general propagation conditions. Author

N65-30882# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.
LOVE WAVE DIFFRACTION IN A VARIABLE THICKNESS SURFACE LAYER Scientific Report No. 5
David Joseph Defanti and John E. Spence Feb. 1965 66 p refs
(Contract AF 19(628)-319; ARPA Order 180-62; ARPA Order 292-62; Proj. Vela)
(AFCRL-65-155; AD-617148)

Consideration is given to a mathematical analysis of a special case of seismic wave phenomena. In particular, the mixed boundary value problem of Love wave propagation in a solid layer over a solid half-space is investigated where the layer undergoes an abrupt change in thickness: Both the layer

and half-space are considered to be homogeneous elastic media. Theoretical background for the physics of the problem is provided by presenting the fundamentals of elastic wave propagation with specialization to the Love wave case and by a statement of the physical nature and mathematical form of applicable boundary conditions. Interest is focused on the amplitudes of the transmitted and reflected Love waves relative to the magnitude of the excitation, i.e., the transmission and reflection coefficients, for a range of both the "strength" of the discontinuity (magnitude of change in thickness relative to layer thickness) and the layer thickness. Author

N65-30890# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
INVESTIGATION OF SHORT-PERIOD SEISMIC NOISE IN MAJOR PHYSIOGRAPHIC ENVIRONMENTS OF CONTINENTAL UNITED STATES Final Report, 1 Sep. 1961–31 Dec. 1964
G. E. Frantti Bedford, Mass., ATCRL, Jun. 1965 36 p refs
Its Rept.-4711-22-F/5178-47-T
(Contracts AF 19(628)-200; AF 49(638)-1170; ARPA Order 180-61; ARPA Order 292-64)
(AFCRL-65-406; AD-617122)

Measurements of spectral density levels of short-period seismic noise are obtained for points distributed throughout the continental United States and for a few non-North American locations. Noise amplitudes and gradients in the far field correlate on a regional basis with major physiographic provinces, as revealed by iso-particle-velocity contouring. The ensemble of space and time samples of noise is examined to illustrate the average spectrum and dispersion for three orthogonal components of ground-particle velocity in the range 0.25 to 100 cps. Probability distributions of noise amplitudes based on a collection of space averages and time averages are presented for several frequencies. The ratio of horizontal to vertical noise amplitude (H/Z) exceeds the theoretical value for simple Rayleigh waves and shows a frequency-dependent variation with regional geologic environment. Author

N65-30892# National Center for Atmospheric Research, Boulder, Colo.
DYNAMICS OF THE UPPER ATMOSPHERE Final Report
Bernhard Haurwitz Bedford, Mass., AFCRL, 30 Apr. 1965 20 p refs
(Contract AF 19(628)-3998)
(AFCRL-65-313; AD-617060)

The lunar tidal variation of the atmospheric pressure at the earth's surface has been determined at 6 stations in North America and Central America. The results confirm previous results about the response of the atmosphere to the lunar tidal force. An analysis of the 24-hourly solar pressure oscillation and its world-wide distribution shows that this oscillation with its irregular distribution and its smallness compared to the 12-hourly solar oscillation can be explained by the geographical distribution and magnitude of the corresponding temperature. The effect of the earth's rotation on internal gravity waves is considered, and formulae are given to estimate quantitatively the effect of the Coriolis force and its variation with the latitude on these waves. Author

N65-30911# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR JULY 1964 FROM SALISBURY, SOUTH AUSTRALIA
Oct. 1964 26 p
(WRE-CPD-1964/7(S))

Tabulations of ionospheric data obtained at Salisbury, South Australia, located at 34.7° S and 138.6° E, are presented. The operating characteristics of the ionosonde used to make the measurements are described. R.N.A.

N65-30958*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATTEMPTS TO INCREASE THE HYDROXYL AIRGLOW ARTIFICIALLY BY RELEASE OF OZONE INTO THE UPPER ATMOSPHERE
A. E. Potter, Jr., and C. S. Stokes (Temple Univ.) Washington, NASA, Aug. 1965 28 p refs
(NASA-TN-D-2972) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Theoretically, the hydroxyl airglow (and possibly also the sodium airglow) could be artificially stimulated by the release of ozone into the upper atmosphere near 90 kilometers. Calculations indicated that the light intensity expected from an ozone release was so low as to be invisible from the ground. Consequently, photometers and a telemetry system were mounted on the rocket that carried the ozone. It was found from the photometer data that the ozone was released inside the hydroxyl airglow layer in the 74-kilometer release, but at the lower edge in the 68-kilometer release. A faint luminosity was observed in both cases. For the release at the lower edge of the airglow layer, this luminosity was attributed mainly to light scattered from Freon-12 "ice" particles into the photometers. The luminosity for the rocket that did penetrate the airglow layer was attributed to chemiluminescence plus scattered light. The upper limit of the total intensity of the chemiluminescence was estimated to be of the order of 10^{-9} watt. This intensity was much less than might have been expected for complete mixing of the ozone with the ambient atmosphere. Evidently, mixing was very imperfect in the experiment. Author

N65-30975# Weapons Research Establishment (Australia).
BASIC ATMOSPHERIC PARAMETERS AS MEASURED BY FOUR FALLING SPHERE EXPERIMENTS AT WOOMERA, AUGUST–NOVEMBER, 1964
P. H. O. Pearson Apr. 1965 37 p refs
(WRE-TN-PAD-99)

A further four falling sphere experiments were conducted at Woomera from August to November, 1964. These results together with an additional wind result are the third part of a series to investigate the seasonal variation of density, temperature, pressure and winds at Woomera shortly after sunset. Author

N65-30989# Army Engineer Nuclear Cratering Group, Livermore, Calif.
PROJECT DUGOUT: APPARENT CRATER STUDIES Final Report
Joseph L. Spruill 3 Aug. 1965 62 p refs
(PNE-601F) CFSTI: $3.00

Dimensions and geometry of the Dugout crater, produced by the detonation of a row of five 18,144 kg nitromethane charges in basalt, were analyzed. The linear portion of the crater was 41.6 meters wide and 10.7 meters deep, 36% wider and 53% deeper than the Pre-Schooner Alfa crater, which was produced by the detonation of an identical charge at the same depth. Lips on the sides of the crater were massive, and were about twice as high as those of the Alfa crater; on the ends of the crater the lips were slightly smaller than the Alfa crater lip. The volume per charge of the linear section of the crater was 70% greater than the volume of the Alfa crater. The greatest range of the rock missiles perpendicular to the row of charges was 2.5 times the greatest missile range from the Alfa detonation. To the ends of the row, rock missile ranges were about the same as for the Alfa

detonation. The average cross section of the linear section of the Dugout crater was a hyperbola. Factors for the enhancement in row charge crater dimensions over those of the comparable single charge crater were generally larger than those developed from the Pre-Buggy II row charges in alluvium. Author

N65-31015# Gt. Brit. Dept. of Scientific and Industrial Research.
DIURNAL VARIATIONS OF THE ELECTRON CONCENTRATION IN THE TOPSIDE IONOSPHERE AT LOW LATITUDES
A. J. Legg and J. W. King Dec. 1964 34 p
(RRS-IM-188)

Topside sounder data of electron concentrations recorded at different times, seasons, latitudes, and altitudes by the Alouette Satellite during October 1962 through October 1963 are presented. All data are related to longitudes between 90° E and 120° E, and an attempt to produce diurnal variations of the electron concentration at altitudes of 300, 400, 500, 600, 800, and 1000 km for each of six different latitudes was made. Interference prevented observations of accurate nighttime ionograms. G.G.

N65-31084# Deutscher Wetterdienst, Offenbach am Main (West Germany).
A STUDY OF THE STRUCTURE OF VERTICAL DENSITY PROFILE
H. Faust Mar. 1965 27 p refs
(Contract DA-91-591-EUC-3384)
(SR-3; AD-464841)

This was a study of the variations and shapes of density profiles in the troposphere and the stratosphere; and the importance of the temperature factor in the fluctuations of these density profiles. The data studied were primarily from Berlin and Munich and from the period from January through June 1955. Some American, Indian, U.S.S.R. and other data were also used. Data were also grouped according to the surface synoptic situation. The author concludes that, "in the vertical distribution of the density, deviations from the exponential curve occur, which must be attributed exclusively to distinct inversions in the atmosphere. From the kind of deviation, the kind or form of the inversion, respectively, can be determined, so that it is possible to deduce in broad outline the temperature profile from the density profile alone." Author

N65-31195# Device Development Corp., Waltham, Mass.
DATA REDUCTION OF CHEMICAL RELEASES IN THE UPPER ATMOSPHERE OF LOW-INTENSITY OPTICAL EMISSIONS CAUSED BY THE RELEASES AND DESIGN AND DEVELOPMENT OF PAYLOADS TO PRODUCE LUMINARY TRAIL AND POINT RELEASES AT ALTITUDES ABOVE 80 KM Final Report, 15 Jul. 1962–15 Oct. 1964
Eckart Gusovius and Roland B. Holt 15 Nov. 1964 53 p
(Contract AF 19(628)-1642)
(AFCRL-65-136; AD-467001)

Two areas of effort are contained in this report. The first covers data acquisition and reduction. The second covers payload design and development. A description of data acquisition instrumentation for Firefly III is set forth. This equipment included various types of camera and photomultiplier arrays. The data processing programs and their operation are described in detail. Studies of wind phenomena between 80 and 130 kilometers was permitted by Firefly III data. A discussion of the conclusions is included. The payload section of the report describes the several models of payloads which have been developed and flown. The special characteristics to provide specific releases are outlined as well as the chemical compositions used. Author

N65-31203# Queen's Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics.
ELECTRON TEMPERATURES IN THE D REGION
A. Dalgarno and R. J. W. Henry [1965] 24 p refs
(Contract AF 61(052)-780)
(AFCRL-65-482; AD-618054)

Detailed estimates are made of the rates of energy loss of electrons moving in the D region and it is argued that the electron gas has a negligible non-thermal component. The Maxwellian velocity distribution of the thermal component is brought about by collisions with molecular nitrogen involving rotational transitions and the distribution is determined by the neutral particle gas temperature. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-30297# Columbia Univ., New York. Plasma Engineering Lab.
TEMPERATURE DETERMINATION IN MODERATELY DENSE, HIGH-TEMPERATURE GASES BY TRANSIENT THERMOCOUPLE PROBES Interim Technical Report
P. S. Tschang Wright-Patterson AFB, Ohio, ARL, May 1965 39 p refs
(Contracts AF 33(615)-1141; AF 49(638)-1395)
(ARL-65-95; AD-617702)

A study has been made to determine the bases of the transient methods of the single probe, the dual-probe, and the intermittent probe for measuring high gas temperatures. Simple parameters critically affecting the probe accuracies have been singled out for comparing the relative merits of the methods under scrutiny. The results indicate no fundamental superiority of any one technique, but in practice the single probe seems most likely to attain the theoretical accuracy by virtue of its simplicity of implementation. The analyses indicate the need to take the variation of all probing parameters into account because of the tendency for these effects to be magnified into large errors resulting in inaccurate gas temperature determination. A novel three-terminal low noise thermocouple sensing element is presented together with its performance in an arc plasma environment. Author

N65-30390* Naval Oceanographic Office, Washington, D. C.
AN AIRBORNE WAVE METER
John J. Schule, Jr. *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 405–407 (See N65-30350 19-13)
CFSTI: HC $7.45/MF $2.25

Flight tests made over Argus Island near Bermuda used two airborne radar systems designed to measure wave heights between two and 50 feet, with an accuracy of 10% from an aircraft flying at an altitude of 500 feet and at a speed of 180 knots. When results with the first system were compared

to data from the fixed wave staff at the tower, the system was found to respond well at short wavelengths but did not reproduce energy peaks accurately. The other system, using FM continuous wave ultimates, minimized effects due to aircraft motion and reproduced energy peaks well, but lacked sensitivity at higher frequencies or shorter wavelengths. M.W.R.

N65-30458*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

LOW LEVEL ACCELERATION MEASUREMENT APPARATUS (LLAMA) Semiannual Status Report, Jan.–Jun. 1965

Shaoul Ezekiel Jun. 1965 9 p refs

(Grant NGR-22-009-080)

(NASA-CR-64119; RN-6) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Two types of displacement detectors are being investigated for a low level acceleration measurement apparatus. One, a more sensitive version of the spot occulation displacement detector, is to be used as a coarse detector to confine the floating magnet within a region of several microns. The other, an interferometer displacement detector, is to act as the high sensitivity detector to confine the magnet within a small fraction of a micron. Attempts are being made to integrate the two detectors into one configuration. Considerable effort has gone into the design and construction of compatible optical hardware components to be used in conjunction with a large surface plate. Several modifications to the low level acceleration measurement dewar were made. R.N.A.

N65-30536# Naval Ordnance Lab., White Oak, Md.

A FOUR CHANNEL OSCILLOSCOPE RECORDING SYSTEM

Ronald B. Tussing Jul. 1965 44 p refs

(NOLTR-65-21; AD-617189)

A control unit using unique solid state circuits forms the basis of a compact, versatile recording system. It is used with an oscilloscope, a camera, and piezoelectric gages to record underwater explosion pressures. The major functions performed by the control unit are to generate a precise calibration step; unshort and connect the firing line; fire the charge; trigger the oscilloscope; provide delays (0–1 sec) for delaying the charge firing or oscilloscope triggering; and provide gage cable terminations. Procedures for calibrating and using the system with typical oscilloscopes and cameras are discussed. Author

N65-30549*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TIROS II RADIATION DATA USERS' MANUAL, SUPPLEMENT

William R. Bandeen 15 May 1962 19 p refs

(NASA-TM-X-56692) CFSTI: HC $1.00/MF $0.50 CSCL 03B

After publication of the *TIROS II Radiation Data Users' Manual* and its companion volume, the *TIROS II Radiation Data Catalog*, additional limitations concerning the usefulness of the data were discovered. This Supplement to the *TIROS II Radiation Data Users' Manual* discusses these additional limitations and elaborates on certain discrepancies originally discussed in the Manual. In spite of these limitations, much valuable information exists in the TIROS II Final Meterological Radiation Tapes. A knowledge of these limitations will allow the user to interpret the data properly. Author

N65-30558# Graflex, Inc., Rochester, N. Y.

DESIGN CONSIDERATIONS INFLUENCING THE SIZE AND COST OF OPTICAL COMPONENTS IN AUTO-INSTRUCTIONAL DEVICES Technical Report, May 1963–Mar. 1964

William H. Trow and Edgar A. Smith (AMRL) Wright-Patterson AFB, Ohio, AMRL, May 1965 38 p refs

(Contract AF 33(657)-11339)

(AMRL-TR-65-80; AD-617609)

The increasing demand for low-priced projectors for self-instructional purposes has prompted investigation of design factors which contribute to the manufacturing costs in this class of product. Because cost and intended use are prime factors, design must be based upon the optimum combination of optical components which satisfies these design objectives. The problems of the projector design itself are considered, primarily the design considerations for optical components that might be used. Recent developments in lens and reflector fabrication methods do not yet permit a reduction of cost below that of conventional methods and designs. Some principles and practices for rear projection are presented, and the interdependence of major factors involved in maximizing screen performance is expressed in mathematical terms. The environmental factors of room illumination level, audience size and the contrast of the filmed material are found to be highly influential in the design of a rear-projection device. Author

N65-30562*# General Dynamics/Electronics, San Diego, Calif.

INFRARED DETECTOR MICROELECTRONIC AMPLIFIERS Final Report

Jun. 1965 32 p Prepared for JPL

(Contracts NAS7-100; JPL-950988)

(NASA-CR-64281; R-65-027) CFSTI: HC $2.00/MF $0.50 CSCL 17E

The mechanical design, component selection and evaluation, electrical performance, component replacement, fabrication, and testing of infrared detector microelectronic amplifiers are discussed. Recommendations for performance and reliability improvement, size reduction, and cost savings are included. Further, the preamplifier component failures, rejections, and performance; and the performance of the intermediate amplifier are tabulated. E.E.B.

N65-30598# Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany). Institut für Kernphysik.

INSTRUMENTS AND MEASURING TECHNIQUES IN NUCLEAR PHYSICS Bibliographies

K. Debertin, comp. May 1964 98 p *Its* Ser. C; Sect. 06

(AED-C-D6-10)

N65-30610# Library of Congress, Washington, D. C. Aerospace Technology Div.

SOVIET INFRARED SENSORS. I: THERMAL SENSORS Surveys of Soviet-Bloc Scientific and Technical Literature

30 Jul. 1965 36 p refs

(ATD-P-65-44)

Soviet scientific articles on thermal sensors are reviewed. The majority of the articles pertain to metallic and semiconductor bolometers used in conjunction with various infrared spectrometers and spectrophotometers in the near, intermediate, far, and very far infrared regions. All the sensors have one characteristic parameter in common: minimum detectable power, which makes it possible to compare sensors operating on different principles. This and other parameters are tabulated and compared for various bolometers and other infrared sensors. R.N.A.

N65-30622*# American Machine and Foundry Co., Alexandria, Va.
STUDY AND DESIGN OF MULTIPLE OR STACKED DETECTORS AND A SINGLE FIXED DETECTOR Second Bi-monthly Progress Report
Feb. 1965 22 p
(Contract NAS9-3587)
(NASA-CR-65081) CFSTI: HC $2.00/MF $0.50 CSCL 14B

Most of the planned program as outlined in the previous progress report has been realized. The performance of the X-ray vidicon detector has been further improved and the operating principle of the flat-plate geiger counter has been established. Complete electronic readout circuits simulating data transmission of a multiple chamber geiger counter over a single telemetry link has been constructed and evaluated. In the area of X-ray optics, a complete simulated Seeman-Bohling camera has been constructed and has undergone preliminary evaluation and shows, in comparison with the Surveyor-type X-ray diffractometer, an increase in intensity by a factor of two with approximately the same resolution, signal-to-background ratio, and X-ray tube power. N.E.A.

N65-30660# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
HEAT TRANSFER TECHNIQUES AND MEASUREMENTS IN THE DOUGLAS AEROPHYSICS LABORATORY HYPERVELOCITY IMPULSE TUNNEL
H. R. Miller Dec. 1964 48 p refs
(SM-43066; AD-616924)

This report presents the theory, fabrication, calibration, and data reduction procedures for thin-film resistance thermometer and calorimeter-type heat transfer rate gages used in a Hypervelocity Impulse Tunnel (HIT). Included, also, is a section on experimental measurements and experience covering the following topics: development of a correlation parameter for stagnation point heat transfer measurements based on Fay-Riddell theory; estimation of the accuracy of experimental measurements; discussion of the effects of flow contamination on heating rates; and comments on heat transfer instrumentation used in the HIT. Author

N65-30735*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COVERAGE DIAGRAMS FOR X-Y AND ELEVATION-OVER-AZIMUTH ANTENNA MOUNTS
Chesley H. Looney, Jr. and Donald J. Carlson Washington, NASA, Aug. 1965 18 p ref
(NASA-TN-D-2963) CFSTI: HC $1.00/MF $0.50 CSCL 17I

At any satellite tracking station, there will occur certain satellite passes which require that the primary-axis shaft of a two-axis antenna mount move at very great speeds (up to infinity) to maintain continuous tracking coverage. Since the speed capability of a shaft is always limited to some finite value, there will be some loss of coverage on those passes which require speeds in excess of the shaft's actual capability. In addition, there may be mechanical limits to the motions of axes which prevent the antenna from scanning the whole hemisphere above the horizon. The losses of coverage for X-Y and elevation-over-azimuth (AZ-EL) antenna mounts are considered in this paper, and it is concluded that the two types of mounts do not differ significantly with respect to the percentage of data lost as a result of shaft speed limitations; however, the relative advantage of the X-Y mount is the fact that the data which it loses is of poor quality, while that lost by the AZ-EL mount is of the best quality. Author

N65-30755# Air Force Cambridge Research Labs., Hanscom Field, Mass.
A MULTI-LEVEL RADAR STORM CONTOUR MAPPER
William E. Lamkin and David Atlas Apr. 1965 32 p refs *Its* Instrumentation Papers No. 57
(AFCRL-65-214; AD-614898)

The design and performance of a multi-level radar storm contour mapper is described. The instrument provides six quantized output signals each of which corresponds to a preselected class of signal intensity or reflectivity. The outputs are coded in a stepped grey scale so that a storm echo is mapped in bands of white, grey, and half grey, interspersed by bands of black; each band corresponds to the selected signal category. The contour coding may be altered so that the contour bands appear dotted or dashed. The system incorporates a wide (80 db) dynamic range receiver to permit mapping of severe storms without saturation, and an alarm to alert the operator in the event the uppermost signal category is exceeded. Resistance-Capacitance (RC) range integration is employed to smooth the highly fluctuating precipitation echoes and provide sharp contour boundaries closely representing the true average signal intensity. The addition of relatively simple integrators to the output lines of each reflectivity class would permit the use of the system for areal rainfall measurements. The system's performance with the FPS-6 height-finder radar and the CPS-9 is illustrated. Author

N65-30756# Western Ontario Univ., London. Dept. of Physics.
VAPOR ADSORPTION ON REFRACTOMETER SENSORS Annual Scientific Report, Nov. 1963–Oct. 1964
Donald R. Hay, Edward H. Turner, and Chia-luan Ting Bedford, Mass., AFCRL, Nov. 1964 101 p refs
(Contract AF 19(628)-3835)
(TP-1; AFCRL-64-968; AD-614844)

The present work defines the physical processes causing the refractivity error and assesses methods of reducing the error. Tests in a wind tunnel on the Hay-Kelk methods of reducing the error. Tests in a wind tunnel on the Hay-Kelk refractometer showed that the response is similar to that of the Hay refractometer with the all-invar sensor when coated with beeswax; the temperature coefficient of the former is about 8 N-units per degree C. The refractivity error for relative humidities exceeding 70 percent is greater when vapor is injected into the air as steam than when evaporated slowly from an open water surface. Quartz in the sensing element causes large errors at high relative humidities. Adsorption upon quartz has no favoured location, in the moving wind stream. The depth of the adsorbed layer is affected little by the application of an electric field. The depth of the adsorbed layer is 3 microns on untreated invar and 1 micron on quartz at a relative humidity of 90 percent, as observed in the wind tunnel, but only about one-ninth of these when studied gravimetrically. An optical ellipsometer has shown the onset of microscopic condensation at relative humidities exceeding 70 percent on untreated invar; the size of the condensation droplets increases until they become visible at humidities approaching saturation. Invisible adsorption occurs over a narrow range of humidities preceding condensation. Author

N65-30760# Army Engineer Research and Development Labs., Fort Belvoir, Va.
THE PHOTOGRAMMETRIC PARAMETERS OF THE CAMERA OF A PHOTOGRAPHIC APPARATUS
G. V. Romanovskiy [1964] 16 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 7, 1964 p 34–46
(T-1765-65; TT-65-62034; AD-614105)

Constants of the photographic apparatus that must be known for photogrammetry by reference to photographs taken with that particular apparatus are discussed. The precise method determines which parameters must be known and with what accuracy. For instance, photographs of a plain locality provided with four reference points can be transformed without knowledge of any apparatus parameter. The most precise and most advanced methods in stereophotogrammetric surveying require the determination of the largest number of parameters. The requirements of the parameters for the most precise stereophotogrammetric methods are considered. Two methods of construction, each requiring different apparatus parameter determination, are discussed. The first is based on the assumption that the photograph is geometrically similar to a central projection of the locality of a plane. The second method assumes that the photograph as a whole is not a central projection of the locality on a plane, this being true only for small areas of the image within which the image defects do not exceed the instrumental errors of the best stereophotogrammetric instruments. E.E.B.

N65-30761# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPTICAL AND RADIO-FREQUENCY CHARACTERISTICS OF A MULTIRAY INTERFEROMETER WITH DIFFRACTION MIRRORS ON THIN DIELECTRIC PLATES

F. A. Korolov and V. I. Gridnev 7 Apr. 1965 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz., Astron. (Moscow), no. 4, 1963 p 14–17
(FTD-TT-65-292/1+2; AD-614766)

A new type Fabry-Perot interferometer with metallic film diffraction mirrors mounted on thin dielectric plates has been developed. Measurement of the resolving power (figure of merit) of the interferometer was measured at wavelengths of 8 and 4 mm. Dependence of the resolving power on the ratio of the diameter of the reflectors to wavelength as well as on the transmission coefficient of the reflectors was demonstrated. Values of the transmission coefficient of the interferometer as a function of the transmission coefficient of the reflector were measured. Author

N65-30824# Naval Research Lab., Washington, D. C.

SOME FACTORS INFLUENCING THE LIFE AND PERFORMANCE RELIABILITY OF HIGH-PRECISION POTENTIOMETERS

V. G. Fitzsimmons and J. B. Romans 12 May 1965 22 p refs (NRL-6287; AD-616893) CFSTI: $0.75

Linear precision potentiometers, which had been subjected to life testing, were studied to determine the relation between lubrication, wear, potentiometer life, operating characteristics, and electrical noise generation. Oil or grease had been used as the contact arm and winding lubricant. Wear was concentrated on contact arms and was most severe where oil had been used. Potentiometers made with precious metal windings showed the least wear. Both oil and grease had been used for lubricating the potentiometer ball bearings. Half the bearings were rough in operation and two were locked because of wear and fretting corrosion products. Contact arm wear scar size showed no correlation with change in total resistance or torque required to operate the potentiometers. Noise levels of all potentiometers rose during the life tests, but those with contact arms having the greatest wear at the end of the tests produced the least noise. Noise increase is related to loss of contact arm lubricant by evaporation, creep, or migration. Recommendations are made for reducing noise, and preventing oil creep and migration. R.N.A.

N65-30889# Northeastern Univ., Boston, Mass.

DESIGN, CONSTRUCTION AND TESTING OF INSTRUMENTATION FOR THE INVESTIGATION OF THE ELECTRICAL STRUCTURE OF THE UPPER ATMOSPHERE Final Report

Robert D. Stuart Bedford Mass., AFCRL, 13 Jan. 1965 12 p (Contract AF 19(628)-3875)
(AFCRL-65-176; AD-617065)

To further understand the physics of the upper-atmosphere, research program work has been carried out on the design, construction and testing of rocket and satellite instrumentation for the investigation of the electrical structure of the upper atmosphere. A description is given of a spherical sensor, and support instrumentation used on rockets and satellites to measure the positive and negative charged-particle densities. A description, in addition to typical results, is also given of some of the data-reduction procedures. Author

N65-30947# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A MAGNETIC BALANCE FOR MEASURING MAGNETIC SUSCEPTIBILITIES

Lawrence Turley James, Jr. (M.S. Thesis) Jun. 1965 72 p refs (SD/PH/65-12; AD-616686)

The final design and construction of a Weiss-Foex magnetic balance were completed and the balance was adapted to make measurements at low temperatures. The balance was used to measure the paramagnetic susceptibility of a rare earth-transition metal compound and to determine the temperature dependence of the susceptibility. The initial measurements and calibrations led to an over-all accuracy of $\pm 6.08\%$ in the range of susceptibilities of from 2 to 100×10^{-6} emu/gram. Ferrous ammonium sulfate and nickel chloride were used as standards for calibration. The compound YCo_2 was investigated and proved to have a paramagnetic moment which followed the Curie-Weiss Law. The "Curie constant" was found to be $.19 \times 10^{-6}$ emu-K°/gram and the "Weiss constant" was found to be 53 K°. Author

N65-30974# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex. Telemetry Working Group.

FOURTH TRANSDUCER WORKSHOP

Jack Lynch et al [1964] 232 p refs Workshop held at Wright-Patterson AFB, Ohio, 18–19 Jun. 1964
(DOC-112-64; AD-616777)

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7. A HYDRAULIC STEP FUNCTION PRESSURE GENERATOR FOR TRANSDUCER EVALUATION J. D. Dykstra (Ballistic Res. Lab.) 22 p refs

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9. VIBRATION ISOLATION OF FLUSH DIAPHRAGM PRESSURE TRANSDUCERS USED ON ROCKET MOTORS Steve Rogero (JPL) 7 p refs

10. IMPROVEMENTS IN PLASTIC FILM PRESSURE TRANSDUCERS J. M. Yarlott and A. B. Dauger (Pratt & Whitney Aircraft) 34 p refs

11. TRANSDUCERS AS PRE-SAMPLING FILTERS IN PULSE CODE MODULATION TELEMETRY SYSTEMS Lawrence W. Gardenshire (Radiation, Inc.) 33 p refs

12. TRANSDUCER TECHNOLOGY AT THE AIR FORCE ROCKET PROPULSION LABORATORY, EDWARDS, CALIFORNIA James B. Lake (AF Rocket Propulsion Lab.) 9 p

13. RESEARCH ON TRANSDUCERS FOR EXTREME ENVIRONMENTAL TEMPERATURES Lawrence Fleming (Bell & Howell Res. Center) 13 p refs

N65-31021# Joint Publications Research Service, Washington, D. C.

PROBLEMS OF SCIENTIFIC INSTRUMENT BUILDING

4 Aug. 1965 27 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 6, 1965 p 3-20

(JPRS-31419; TT-65-31915) CFSTI: $2.00

The status of research and development of scientific instruments and equipment is discussed in several reports given at a meeting of the Presidium of the Academy of Sciences of the U.S.S.R. Suggestions for scientific-research and experimental-design projects are included and emphasis is placed on the coordination of these activities. M.W.R.

N65-31056*# Advanced Technology Corp., Timonium, Md.

SUBMILLIMETER SATELLITE RADIOMETER First Semiannual Engineering Progress Report

R. F. Packard, M. Cohn, R. J. Bauer, J. M. Cotton, Jr., J. W. Dozier et al 15 Jul. 1965 52 p refs *Its* Rept.-50101-8 (Contract NASw-1000)

(NASA-CR-64356) CFSTI: HC $3.00/MF $0.50 CSCL 20F

Two critical components needed for a space-borne submillimeter superheterodyne radiometer are developed. They are a 560 GHz fourth harmonic mixer and a 140 GHz third harmonic generator. An experimental model of the latter has been built and tested using a commercial packaged varactor. Results were poor but better performance is expected with epitaxial varactors now being assembled directly in waveguide structures. Manufacturing techniques have been developed for the construction of precision submillimeter waveguides for use in the 560 GHz mixer and in a signal source built to test the mixer. The mixer has not yet been completed but diode materials for use in it have been studied in millimeter wave devices. Tunnel diodes made with available materials were unsatisfactory in millimeter devices; backward diodes were no better than point contact devices. Data measured with a 140 GHz second harmonic mixer is presented. An analysis of the series parasitic resistance of an idealized diode has been made and suggestions for its reduction are given so that improved mixer performance may be achieved. Author

N65-31072# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

BEAT-FREQUENCY METHOD FOR THE CAPACITANCE MEASUREMENT OF SEMICONDUCTOR NUCLEAR-PARTICLE DETECTORS [POMIAR POJEMNOSCI POLPRZEWODNIKOWYCH DETEKTOROW PROMIENIOWANIA JADROWEGO METODA DUDNIENIOWA]

W. Przyborski Dec. 1964 16 p refs (Rept.-584/II/PS)

Capicitance effects in semiconductor nuclear particle detectors, the principle of capacitance measurement methods and the apparatus constructed are discussed briefly. Voltage-capacitance characteristics for the surface barrier, thermal diffused, and Li^+ ion-drifted detectors are presented. Author

N65-31077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD FOR MEASURING THE ENERGY OF SHORT-WAVE SOLAR RADIATION AND ALSO ARTIFICIAL RADIATION AT WAVELENGTHS SHORTER THAN 1350 A

A. V. Chudaykin, T. V. Kazachevskaya et al 21 May 1965 6 p Transl. into ENGLISH from Russian Patent no. 161506 (Appl. no. 786445/26-10, 13 Jul. 1962) 2 p

(FTD-TT-65-466/1; AD-617667)

A method for satellite measuring of short-wave solar energy and artificial radiation at wavelengths below 1350 Å is proposed, that utilizes ceramic plates covered with a semiconducting heating layer which in turn is covered by the thermolucent phosphor $CaSo_4$(Mn). The previously irradiated plate is placed in the window of a photo receiver, warmed, and the images from the photoreceiver are then transmitted to the ground station. Filters with various transmission coefficients can be used to measure the radiation in different portions of the spectrum. The plates can be used again after removal from the photo receiver and complete cooling. G.G.

N65-31138*# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.

ACCELERATION COMPENSATED LOW LEVEL PRESSURE TRANSDUCER

Samuel Lederman and Marian Visich, Jr. Washington, NASA, Aug. 1965 27 p refs

(Grant NsG-409)

(NASA-CR-286) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The design and development of a miniature high sensitivity acceleration compensated crystal pressure transducer is described. It is shown that the transducer has the necessary characteristics in terms of response, sensitivity and linearity for application in low density shock tunnels and shock tubes. The pressure range can easily be varied over a wide range without affecting the resolution capability referred to the full scale of a given transducer. Author

N65-31184*# Maurer (J. A.), Inc., Long Island, N. Y.

WIDE SPECTRAL RANGE LENS FOR 70mm HAND-HELD GEMINI CAMERA Final Report

15 Jul. 1965 149 p

(Contract NAS9-3563)

(NASA-CR-65097; GOP-2285) CFSTI: HC $4.00/MF $1.00 CSCL 14E

A feasibility study of specifications for the optical design of a wide spectral range lens for a 70 mm hand-held general purpose camera to be used by astronauts as a tool for technical and scientific photography during orbital flight was conducted. Discussed are optical materials studied, chromatic aberration problems including sphero-chromatism, and field aberrations. Graphs, tables, and charts are included; and recommended specifications are presented, along with a discussion of the resolution performance and other experimental results. L.S.

N65-31192# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SIMPLE CALORIMETRIC METHOD OF MEASURING X-RAY RADIATION DOSAGES

Z. Kovar 15 Jul. 1965 19 p refs Transl. into ENGLISH from Jaderna Energie (Czechoslovakia), v. 9, no. 10, 1963 p 319–323
(FTD-TT-65-363/1+2+4; AD-467267)

In this report is described a simple calorimetric method for direct and absolute measurement of absorbed dosages and for calibration of a bundle of X-rays. The proposed method of measuring was checked by current means of physics labs and is suitable especially for X-ray radiation of greater effects and higher energies, they are used for example in roentgenotherapy, defectoscopy or in radiation chemistry. Author

N65-31246# Sandia Corp., Albuquerque, N. Mex.
APPARATUS FOR THE MEASUREMENT OF THE HALL EFFECT IN METALS
R. C. Heckman Aug. 1965 14 p refs
(SC-RR-65-325) CFSTI: $1.00

This paper describes an apparatus for the measurement of the Hall effect in metals. The apparatus utilizes cross-modulation of the sample current and magnetic field. Comparison with other schemes of Hall effect measurement is presented. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-30342# Sperry Rand Corp., Blue Bell, Pa. UNIVAC Div.
INVESTIGATION OF LOGIC CIRCUIT COMPLEXES "RELIABILITY AND FAULT-MASKING IN n-VARIABLE NOR TREES" Scientific Report No. 1
M. Dunning, B. Kolman, and Leon Steinberg 15 Apr. 1965 87 p refs
(Contract AF 19(628)-4051)
(AFCRL-65-295; AD-617516)

Three methods for masking faults in the general tree by adding NORs are developed to yield restoring, quadding, and generalized majority trees. Methods of computing system, function, and signal state reliabilities are presented as functions of the failure probabilities of the diodes and transistors which compose the trees. Computation of system reliability is considered, and upper and lower bounds are computed for quadded and restored trees. These computations are made for n = 1, 2, 3, and 4, and the resultant curves provide comparisons between the fault masking techniques under consideration as well as comparisons between upper and lower bounds for system reliability. Curves are drawn for n's of system reliability for the three types of trees as functions of NOR element reliability. Representations of the n-variable functions using multiple input NORs are discussed, and restored and quadded versions of these inputs are described. A method is given for selecting the number of inputs of the NOR to optimize system reliability of the general n-variable multiple input NOR tree. M.W.R.

N65-30432 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CASTING OF LARGE THIN-WALLED PARTS BY METHOD OF ORIENTED-SEQUENTIAL CRYSTALLIZATION
V. D. Khramov and Ye. V. Mishakov *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 3–25 refs (See N65-30431 19-17)

Magnesium alloy castings with length up to three meters and wall thicknesses of three to four millimeters are considered. Various casting methods are discussed relative to alleviating unfilled edges, nonmetallic inclusions, and shrinkage cavities. After giving reasons why these methods are unsatisfactory, the method of oriented-sequential crystallization is shown to satisfy magnesium alloy casting requirements. A detailed description includes the feed of metal into the mold, overflow receptacles, passage of metal through sprue pipes, heating of pipes, sprue pipes with nipples, and electroheating of sprue pipes. Some theoretical prerequisites for designing the process are given, and graphs and tables of flow rates are included. Basic advantages are discussed, and some mechanical properties of samples cast by this process are tabulated. C.T.C.

N65-30433 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRESSURE CASTING AND ITS HYDRODYNAMIC BASES
V. Ya. Tarutin and Ye. S. Stebakov *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 26–48 (See N65-30431 19-17)

To alleviate the hydraulic losses associated with a decrease in wall thickness, a method of pressure casting is described, and the theory is discussed. A system of differential equations, used to derive a formula for determining the law of change of angular velocity of approach matrices from any conditions of metal flow during mold filling, are among the equations given. It is concluded that the hydrodynamic peculiarities of pressure casting promote the removal of gases and hard inclusions from alloy. A high degree of surface purity and accuracy of geometric dimensions can be obtained, and thin walled panels of large dimensions are possible. C.T.C.

N65-30461*# IIT Research Inst., Chicago, Ill. Technology Center.
INVESTIGATION OF SLIP RING ASSEMBLIES Final Report, 5 Mar. 1964–5 May 1965
O. M. Kuritza [1965] 63 p
(Contract NAS8-5251)
(NASA-CR-64218) CFSTI: HC $3.00/MF $0.75 CSCL 09C

A laboratory investigation of miniature slip ring assemblies was conducted. This investigation was a continuation of the initial program whose objectives were to determine the influence of ring, brush and insulator materials on electrical noise and mechanical wear characteristics. The noise characteristics of experimental and commercial capsules were studied. Extensive run-in tests have demonstrated that destructive galling and erosion effects occur primarily in unlubricated systems which permit high localized temperatures. Surface lubrication with P-38 synthetic oil has been found to be effective in minimizing wear and maintaining low noise levels. Spectrographic analysis of wear debris indicated that the only constituent was gold from the ring and brush surfaces. Microhardness measurements were made on electrodeposits from rhodium, palladium, and platinum modified gold baths, but no significant increase in plate hardness was obtained. Preliminary study of vacuum operation showed that under the conditions of medium vacuum surface lubrication was still effective in minimizing wear deposits. Author

N65-30464*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
91/2-FOOT DIAMETER MASTER AND MIRROR Final Report

/ts Doc. No. 64SD540 20 Mar. 1964 222 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950239)
(NASA-CR-64204) CFSTI: HC $6.00/MF $1.25 CSCL 13H

The design, fabrication, and optical inspection of a plastic spincast female master mold for producing a 9.5-foot diameter male paraboloidal master are described. The male master is used to produce lightweight high quality paraboloidal solar concentrators with collector absorber efficiences of 75% when operating a 2000° K black body cavity. R.N.A.

N65-30472*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INDUSTRIAL TECHNIQUES BULLETIN
Oct. 1962 9 p
(Contract NAS7-100)
(NASA-CR-64203) CFSTI: HC $1.00/MF $0.50 CSCL 13K

A number of devices are described which are by-products of space research. These inventions include a quick disconnect coupling, a liquid nitrogen–gaseous nitrogen separator, a Keensert installation tool, a cable plug puller, a tube joint and cutting tool, snap-in connectors for miniaturized circuits, and a heatsink for soldering and welding electrical connections. R.N.A.

N65-30505# Battelle Memorial Inst., Columbus, Ohio.
A STUDY OF THE INFLUENCE OF LUBRICANTS ON HIGH-SPEED ROLLING-CONTACT BEARING PERFORMANCE. PART V: RESEARCH ON ELASTO-HYDRODYNAMIC LUBRICATION ON HIGH-SPEED ROLLING CONTACTS Final Report
Jerrold Kannel, J. Clarence Bell, J. A. Walowit, O. A. Ullrich, and C. M. Allen Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jul. 1965 89 p refs
(Contract AF 33(615)-1311)
(ASD-TDR-61-643, Pt. V; AD-467173)

The effects of lubricants on the performance of heavily loaded rolling-contact elements have been studied experimentally and theoretically. Measurements of the deformations of lubricated rolling elements have been made using an X-ray technique for a range of loadings, temperatures, rolling speeds, and lubricants. A qualitative agreement appears to exist between variations in deformation profiles with lubricant types and variations in existing fatigue life with lubricant type. Efforts have been made to infer film pressures from the deformation measurements. Film pressures have been measured between steel as well as quartz disks using a manganin pressure transducer. For the heavily loaded conditions, a slight pressure spike appears in the measurements of pressures between steel disks. Stresses in the rolling elements have been inferred from the pressure measurements. The magnitudes of the maximum stresses do not deviate significantly from the Hertzian stresses although the location of the maximum shearing stress is much closer to the surface. The temperature on the surface of a pair of quartz disks has been measured using an evaporated resistance thermometer type transducer. The magnitude of the measured apparent temperature appears to be higher than anticipated resembling the peak temperature predicted assuming no heat loss from the lubricant to the disk for the pass of each fluid element through contact. Author

N65-30513# Columbia Univ., N. Y. Lubrication Research Lab.
EQUILIBRIUM CHARACTERISTICS OF AXIAL GROOVE GAS LUBRICATED BEARINGS
V. Castelli and J. Pirvics [1965] 73 p refs
(Contract Nonr-266- (88))
(Rept.-1; AD-617415)

This report contains the description of a new general method for the solution of Reynold's equation for compressible and incompressible lubrication. A great improvement in numerical stability and speed of convergence is derived for all fluid film geometries including converging-diverging ones. The method is used for the determination of load coefficients and attitude angles of three- and four-pad axial groove cylindrical bearings. Author

N65-30514# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A METHOD OF TARGET PREPARATION BY ELECTRO-SPRAYING DIRECTLY ON SEMICONDUCTOR DETECTORS
M. Dakowski, H. Piekarz and M. Sowinski Jan. 1965 16 p refs
(Rept.-595/IA/PL)

A method of preparing thin /2 ug/cm^2 ÷ 1.5 mg/cm^2/ and uniform U^{6} and U^{235} targets by electro-spraying directly on semiconductor detector was used. No changes in the resolutions, active areas and volt-amper characteristics of the detectors were observed. Author

N65-30545*# IIT Research Inst., Chicago, Ill. Technology Center.
INVESTIGATION OF SLIP-RING ASSEMBLIES Quarterly Report No. 7, 5 Nov. 1964–5 Feb. 1965
J. L. Radnik [1965] 13 p
(Contract NAS8-5251)
(NASA-CR-64251; E6000-21) CFSTI: HC $1.00/MF $0.50 CSCL 13I

Run-in tests were performed with experimental and commercial capsules to determine the effects of surface lubrication by a heavy layer of P-38 synthetic oil. Lubrication with a graphite oil mixture was also evaluated. Experimental capsules were fabricated to simulate the constructional features of commercial assemblies and to achieve the thermal isolation that exists between rings in an actual assembly. The effects of palladium additions to a gold plating bath were evaluated and a drive system for operation in a vacuum chamber was designed. Run-in tests demonstrated that destructive galling and erosion effects occur primarily in unlubricated systems which permit high localized temperatures. All unlubricated capsules containing isolated rings exhibited severe seizing or high friction effects leading to permanent damage of the rings and brushes. Surface lubrication with P-38 oil was effective in minimizing wear and noise levels in experimental and commercial capsules. Electrodeposits from rhodium and palladium modified gold baths did not exhibit any significant increase in plate hardness. In the case of rhodium, an actual decrease was obtained. R.N.A.

N65-30665# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC WELDING Selected Articles
14 May 1965 23 p refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), v. 143, no. 2, 1965 p 23–33
(FTD-MT-65-63; AD-615536)

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1. DIFFUSION BONDING IN CARBON DIOXIDE V. T. Slepukha p 1–8 refs (See N65-30666 19-15)
2. DIFFUSION BONDING G. K. Kharchenko p 9–19 refs (See N65-30667 19-15)

N65-30666 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIFFUSION BONDING IN CARBON DIOXIDE
V. T. Slepukha *In its* Autom. Welding 14 May 1965 p 1–8 refs (See N65-30665 19-15)

The possibility is considered of replacement, in certain cases, of the vacuum by a readily-available gas medium. Welding conditions and mechanical properties of the joint are given. Author

N65-30667 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIFFUSION BONDING
G. K. Kharchenko *In its* Autom. Welding 14 May 1965 p 9–19 refs (See N65-30665 19-15)

The peculiarities of diffusion bonding of uniform and heterogeneous materials are considered, and industrial application of this method of welding and utilized equipment are described. Author

N65-30676# National Research Council of Canada, Ottawa.
A METHOD OF SOLVING THE CONTACT-HYDRODYNAMIC PROBLEM [O METODE RESHENIYA KONTAKTNO-GIDRODINAMICHESKOI ZADACHI]
D. S. Kodnir 1964 14 p refs Transl. into ENGLISH from Tr. Tret'ei Vsesoyuznoi Konf. Po Treniyu i Iznosu v Mashinakh, vol. 3, 1960 p 58–66
(NRC-TT-1112)

The operating conditions of two adjacent elastic surfaces, which are separated by a film of lubricant and are in relative motion, were considered. Using the formula for the dependence of oil viscosity on pressure, expressions were obtained for the hydrodynamic pressures in the oil layer with and without taking into account the dependence of viscosity on pressure. This theoretical supposition was confirmed by measuring the thickness and shape of the oil film in a laminated bakelite sliding bearing; the measuring device was based on the capacitance' principle. An explanation is given of why a nonmetallic bearing lubricated with water frequently operates better than one lubricated with oil, and experiments confirmed this hypothesis. Various gaps were considered and gap function equations were written. The load carrying capacity of several bearings and gap formations is also discussed. C.T.C.

N65-30700# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
AN EXPERIMENTAL DETERMINATION OF ULTRASONIC LONGITUDINAL WAVE VELOCITIES THROUGH NOSE CONE MATERIALS AT SEVERAL TEMPERATURES AS A FUNCTION OF LAMINATION ANGLE
Anton John Dorr (M.S. Thesis) Jun. 1965 72 p refs
(GSP/PH/65-09; AD-616746)

Ultrasonic longitudinal wave velocities of nose cone materials were measured as a function of the lamination angle at several temperatures between 25° C and 125° C. Wave velocity at 3 Mc was obtained by measuring directly the transit time through a sample and dividing into the measured sample thickness. A maximum wave velocity uncertainty of 1.5% was obtained. It was found that the longitudinal wave velocity vs lamination angle curve maintains the same shape (for a given material) for temperatures between 25° C and 125° C. Furthermore, it was found that the wave velocity vs lamination angle curve can be predicted to within 2-1/2% by an empirical equation involving only the the lamination angle, θ (taken as the angle between the grain of the sample and the direction of sound propagation); c(0°), the measured wave velocity at an angle of 0° ; and c(90°), the measured wave velocity at an angle of 90° . Finally, it was found that the longitudinal wave velocity of certain materials varies as much as 25% between lamination angles of 0° and 90° , while other materials show less or no variation at all. Author

N65-30744# Columbia Univ., New York. Statistical Engineering Group.
MINIMUM COST REPLACEMENT UNDER MARKOVIAN DETERIORATION
Peter J. Kolesar 1 Feb. 1965 43 p refs
(Contract Nonr-266(55))
(TR-26; AD-612479)

Optimal replacement programs for equipment subject to Markovian deterioration are considered. Interest is in determining the structure of the replacement policies that minimize the long run average costs. In particular, conditions under which control limit replacement rules are optimal are determined. In addition results are obtained indicating that linear programming is an efficient method for computing optimal policies. Author

N65-30752# Mechanical Technology, Inc., Latham, N. Y.
ANALYSIS OF A HYDROSTATIC JOURNAL BEARING LUBRICATED BY CONDENSING STEAM
T. Chiang 24 Mar. 1965 44 p refs
(Contract Nonr-3731(00) (FBM))
(MTI-65TR11; AD-614804)

This report presents an analytical investigation of the externally-pressurized, steam-lubricated journal bearing. In the case under consideration, the supply steam is saturated (or slightly superheated) and the bearing temperature is lower about 20 F than that of the supply steam. Two models are used in the analysis: A. Steam condenses completely into water at the bearing (film) inlet and re-evaporates somewhere before the exit. B. After entering the film, steam becomes a two-phase mixture, but it remains to be a homogeneous fluid. The wet steam becomes dry again before the exit. It is shown, based on Model B, that the steam bearing does not deviate much from a gas bearing. Based on Model A, an analysis is performed and solutions are obtained by perturbation calculation based on the eccentricity ratio, ϵ. The results are valid for small ϵ only. Numerical calculations have been programmed on the IBM 1620 computer. Author

N65-30759# Columbia Univ., New York. School of Engineering and Applied Science.
OPTIMAL RANDOMIZED REPLACEMENT UNDER MARKOVIAN DETERIORATION
Peter J. Kolesar (Imperial Coll., London) 15 Apr. 1965 28 p refs
(Contract Nonr-266(55); Grant NSF GP-2202)
(TR-27; AD-614120)

The nature of the optimal replacement rules for a system subject to Markovian deterioration and failure is studied. It is shown that under a generalized aging property a randomized control limit rule maximizes the expected cycle length of the system subject to an upper bound on the probability of failure. Author

N65-30768# Goodyear Aerospace Corp., Akron, Ohio.
TEST AND EVALUATION OF AN M-151 AIR CUSHION CONVERSION KIT
Lallan L. Mc Farland Ft. Eustis, Va., Army Aviation Materiel Labs., May 1965 69 p refs
(Contract DA-44-177-AMC-143(T))
(GER-12121; USAAML-TR-65-19; AD-616105)

This report describes the results of a test program conducted to evaluate an air cushion kit for the M-151 jeep. The kit utilizes air cushion principles to increase mobility in low-bearing terrain. Quantitative tests were conducted in soft clay with a cone index of less than 30, and on a hard surface. In addition, qualitative tests were conducted in water and over varied terrain. Tractive effort was shown to decrease as cushion pressure increased and the vehicle was successfully operated in water and over varied terrain. Author

N65-30788# Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON TUBE MOUNTS Quarterly Progress Report, 1 Jan.–31 Mar. 1965
J. G. Thomas [1965] 19 p
(Contract DA-36-039-SC-86741)
(QPR-11; AD-616908)

Fabrication of redesigned tooling for use with the 600-watt welder was completed. Satisfactory performance was established during the fabrication of 36 sub-assemblies, and a complete 6080WB electron-tube mount was obtained using the new tooling and a modified assembly sequence. The welder with tooling was then redelivered to Tung-Sol, and operator training was initiated. Also, a precision fixture for crimping stem leads was designed and fabricated. Components welding has been delayed by the effort required for the redesign of tooling. However, design studies of a 600-watt welder with special low clamping forces for welding frame grids have been initiated. Author

N65-30841*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
STATISTICAL INTERFACE-LEAKAGE ANALYSIS AND FEASIBILITY OF SUPERFINISHED SURFACES FOR SEALING Final Report, Jan. 1964–Mar. 1965
L. G. Gitzendanner and F. O. Rathbun, Jr. 1 May 1965 155 p refs
(Contract NAS8-4012)
(NASA-CR-64332) CFSTI: HC $5.00/MF $1.00 CSCL 11A

The feasibility of using extremely fine finished surfaces as mating components for sealing in fluid connectors under stresses less than the yield strengths of the materials was investigated and a statistical analysis was performed of the leakage interface phenomenon. It was found that seals which reduce leakage rates to below 10^{-6} atm cc/sec at internal pressures up to 2000 psi are possible by pressing together parallel superfinished metal surfaces. The stress required to produce such a seal is less than the yield strength of the metals used. Up to ten successful assemblies of the same components are possible. Finishing techniques which yield surfaces capable of producing such seals are given. Present cost for a single component surface finishing is $100 per surface. For quantities as low as ten, this cost can be reduced to about $70 per surface. These costs are valid for developmental surfaces only and do not represent realistic costs for large quantity lots. E.E.B.

N65-30846*# Little (Arthur D.), Inc., Cambridge, Mass.
DEVELOPMENT OF HIGH FLOW HYDRAULIC SYSTEM FILTERS Final Report
Peter A. Reiman Jul. 1965 89 p refs
(Contract NAS8-11642)
(NASA-CR-64314; C-66516) CFSTI: HC $3.00/MF $0.75 CSCL 13K

A summary on research and development of high flow hydraulic system filters for use in the engine gimbal actuator system of the Saturn S-1C launch vehicle is presented. Over 150 samples of candidate filter media were evaluated, and an improved depth filter composed of randomly oriented four- and eight micron stainless steel fibers was finally selected. This filter holds up to five times as much collected particulate matter as conventional woven wire cloth filters before reaching an arbitrary cutoff pressure drop. The use of long fibers for web construction and sintering of the medium assembly after pleating kept fiber migration to a minimum, but testing of the medium indicated some lack of uniformity. Disposable depth-type filters incorporating fine glass fibers showed a comparable filtration efficiency and achieved true depth collection. G.G.

N65-30867# Koppers Co., Inc., Monroeville, Pa.
DEVELOPMENT OF HIGH TEMPERATURE SEAL-LUBRICANT DEPOSIT EVALUATION TECHNIQUES Technical Report, 1 Jan.–30 Nov. 1964
Billy D. Pfoutz, William G. Knox, and Frank Gannon Wright-Patterson AFB, Ohio, Aero Propulsion Lab., 3 May 1965 21 p
(Contract AF 33 (615)-1112)
(AFAPL-TR-65-3; AD-617072)

Testing techniques for evaluating experimental gas turbine lubricants in face-riding main shaft jet engine seals at temperatures representative of high mach aircraft have been under development. Using the ASD Seal Rig, repeatable evaluation techniques were developed for MIL-L-9236 type lubricants that were indicative of performance in engines. The present phase of the program is directed towards refining evaluation equipment and preparing the rig for more advanced research work. During the period covered by this report, internal seal head air heating to 1160° F, preliminary evaluation studies using 0-60-19 and 0-60-18 lubricants and engineering features of a new seal head design were investigated. An adaptor to permit the use of the seal head with Erdco test equipment is being designed. Author

N65-30880# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEAMLESS TUBES: A TECHNICIAN'S HANDBOOK
Ya. L. Vatkin, O. A. Plyatskovskiy, and Yu. I. Vashchenko 9 Apr. 1965 207 p refs Transl. into ENGLISH of "Besshovnyye Truby: Spravochnoye Rukovodstvo dlya Rabochikh" Moscow, Gos. Nauchno-Tekhn. Izd. Lit. po Chernoy i Tsvetnoy Met., 1963 182 p
(FTD-TT-64-1255/1+2; AD-617101)

The book describes in a concise and comprehensible form the basis of the production technology of seamless pipes as well as the individual plant units, which will aid the pipe workers to increase their professional knowledge. The book does not pretend to be an exhaustive description of the material and is merely a manual. It may also be useful to students of technical schools of metallurgy. TAB

N65-30909# Roentgen Technische Dienst N. V., Rotterdam (Netherlands).
NON-DESTRUCTIVE WELDING Quarterly Report No. 13, 1 Jul.–30 Sep. 1964
30 Mar. 1965 17 p Transl. into ENGLISH from DUTCH
(EURAEC-1342)

Results of an ultrasonic examination of 200 and 300 mm thick welds were compared with those of a destructive examination. Slices cut out of the weld were radiographed and subjected to etching, macroscopic, and magnetic examination. The presence of all discontinuities detected were confirmed in the destructive tests. Their position was indicated with an accuracy of less than 5 mm. Structural changes did not interfere with the results. There was no correlation between the echo amplitude and the size of the defects present. Two probes were necessary to find two dimensional defects perpendicularly

orientated to the plate surfaces. Detection with a single was possible by elevated gain setting but other discontinuities were then presented with exaggerated echoes which tended to obscure the pattern. Defects near the weld surface were difficult to detect unless the surfaces were smoothly machined. Discontinuities lying together could not be analyzed as separate defects. R.N.A.

N65-30930# Automation Industries, Inc., Danbury, Conn.
ULTRASONIC TECHNIQUES FOR FUEL TANK CORROSION EVALUATION Technical Report, Jun. 1964–Mar. 1965
Emerson V. Briggs Wright-Patterson AFB, Ohio. Res. and Technol. Div., Apr. 1965 20 p
(Contract AF 33(615)-1664)
(RTD-TDR-63-4193, Pt. II; AD-467006)

This program provided for minor modifications to the Ultrasonic Inspection System to provide an improved capability to detect corrosion in the bottoms of integral fuel tanks on more types and sizes of aircraft than the equipment was originally intended for. The equipment was tested under actual service conditions in the field to determine its capabilities. Author

N65-31051*# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
BEARING LUBRICANT ENDURANCE CHARACTERISTICS AT HIGH SPEEDS AND HIGH TEMPERATURES Progress Report No. 11, 1 Apr.–30 Jun. 1965
G. Chiccarine, R. H. Pilkington, R. B. Evan, and C. J. Wachendorfer 20 Jul. 1965 63 p refs Revised
(Contract NASw-492)
(NASA-CR-64183; AL65T056) CFSTI: HC $3.00/MF $0.75

A bearing-lubricant combination consisting of a hydrocarbon lubricant with a proprietary lubricity additive, and M1 tool steel bearings having a smoother surface finish on the inner ring than on the outer ring was tested. Ten bearings tested at 600° F and 42 800 rpm ran for bearing lives of 300 to 700 million revs. without any sign of failure, indicating an experimental L_{10} in excess of twice the AFBMA computed L_{10} life under the load and speed conditions used. Two modified polyphenyl ether lubricants, and a more viscous version have somewhat improved performance at temperatures of 500° to 600° F in a nitrogen atmosphere over the more conventional 5-ring polypnenyl ether, Skylube 600. The modified polyphenyl ethers tested in nitrogen atmosphere have about comparable performance to Skylube 600 tested in the air. Surface distress, cage failure, and smearing or gross metal transfer were identified as the three failure modes encountered in high-speed, high temperature, thrust-loaded bearings. R.W.H.

N65-31057*# Electra Mfg. Co., Independence, Kans.
[DEVELOPMENT OF A MINIATURE SOLID-STATE CURRENT LIMITER] Monthly Progress Report, June 1965
G. A. Swartz 23 Jul. 1965 3 p
(Contract NAS5-3834)
(NASA-CR-64352) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Progress is reported on the development of a miniature solid state current limiter and a nondestructive means of current limiter characteristic production. Additional modifications of the element configuration for the one through five amp current limiters are being investigated to meet requirements. R.N.A.

N65-31063*# American Machine and Foundry Co., Alexandria, Va.
STUDY AND DESIGN OF MULTIPLE OR STACKED DETECTORS AND A SINGLE FIXED DETECTOR Final Report
Apr. 1965 54 p refs
(Contract NAS9-3587)
(NASA-CR-65082) CFSTI: HC $3.00/MF $0.50 CSCL 20F

The feasibility and design concepts using multiple or stacked detectors, a single fixed detector, or other pertinent detectors to detect and record an X-ray diffraction spectrum without utilizing mechanical scanning mechanisms are under study. This program was approached from three viewpoints: X-ray optics, detecting systems, and data handling and presentation. The most advantageous optical design was found to be the focusing geometrical arrangement. Two prototype focusing cameras were designed and constructed. The optical system was evaluated with a standard scintillation detecting system using pulse height discrimination. The use of high-speed Polaroid film when combined with fluorescent intensifying screens provides a suitable method of detecting and recording an X-ray diffraction spectrum. A data handling and presentation system was constructed to provide economical and realistic representation of the functions of a space system. R.W.H.

N65-31078# General Motors Corp., Bristol, Conn. New Departure Div.
INVESTIGATION OF HIGH TEMPERATURE BEARING ELEMENTS Progress Report, 1 Jul.–30 Sep. 1964
C. J. Zupkus, H. R. Ludwig, and A. R. Leveille [1964] 59 p refs
(Contract AF 33(615)-1208)
(PR-3; AD-613676)

The Phase I, Part A requirement of screening eight materials has been completed. Test results have been analyzed for both the rolling and sliding specimen configurations and for the oxidation testing. This screening has reduced the number of test materials to three in the Phase I, Part B testing. The testing program for Phase II has been established. Author

N65-31079# General Motors Corp., Bristol, Conn. New Departure Div.
INVESTIGATION OF HIGH TEMPERATURE BEARING ELEMENTS Progress Report, 1 Apr.–30 Jun. 1964
C. J. Zupkus, H. R. Ludwig, and A. R. Leveille 1 Jul. 1964 35 p refs
(Contract AF 33(615)-1208)
(PR-2; AD-613675)

The 2500° F test rig has been assembled and checked out for reliability. A technique of calibration has been established which eliminates the need for individual calibration curves of strain beam reading versus force. Studies hazve been conducted to determine the basis of interpreting oxidation behavior and rolling friction forces. The design of the sliding friction test specimen has been established. Author

N65-31178*# Bendix Corp., Southfield, Mich. Research Labs. Div.
DESIGN, FABRICATION AND TEST OF A FLUID INTERACTION SERVOVALVE Final Report
17 May 1965 40 p
(Contract NAS3-5212)
(NASA-CR-54463; BRLD-2978) CFSTI: HC $2.00/MF $0.50 CSCL 13G

A laboratory model of a pneumatic-input servovalve that operates without the use of moving mechanical parts was built and tested. Interactions of fluid streams have been used instead of moving parts. This servovalve has the output characteristics of a four-way open-centered valve. The model was designed to operate with supply pressure of 5.16×10^5 N/m^2 g (75 psig) air and with standard atmosphere (14.7 psia) exhaust. Tests

demonstrated a 60 percent pressure recovery and a 44 percent flow recovery. The report presents design details, test results, and suggestions for improving performance. Author

N65-31180*# Martin Co., Baltimore, Md.
DESIGN STUDY FOR LUNAR EXPLORATION HAND TOOLS Second Quarterly Report
Donald S. Crouch Apr. 1965 54 p
(Contract NAS9-3647)
(NASA-CR-65093; ER-13852) CFSTI: HC $3.00/MF $0.50 CSCL 13I

The purpose of this report is to present the results of the second three months work performed for the Design Study of Lunar Exploration Hand Tools. A lunar surface geological task analysis was performed to determine the tool function requirements of the astronaut. A number of potential design approaches were considered, and various analyses were performed where required. A series of feasibility tests were conducted in order to evaluate the selected potential design approaches. In particular, potential interface problems between the spacesuited astronaut and geological exploration tools were studied. Design approaches for most of the tools have been selected, and detail design and fabrication of these tools is currently in progress. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-30208 Library of Congress, Washington, D. C. Aerospace Technology Div.
REVIEW OF SOVIET RESEARCH ON OPTICALLY PUMPED SEMICONDUCTOR LASERS
Charles Shishkevish *In its* Foreign Sci. Bull., Vol. 1, No. 7 Jul. 1965 p 1–5 refs (See N65-30207 19-34)

A review is presented of the research which led to the development of the first Soviet optically pumped semiconductor laser. Both indirect and direct transition laser studies are reveiwed. A description is given of a GaAs laser pumped by a ruby laser and the Stokes component of Raman scattering from nitrogen irradiated by a ruby laser. Author

N65-30242# Hughes Aircraft Co., Culver City, Calif.
CONTINUOUSLY PULSED LASER DEVICE FOR SURVEILLANCE Third Quarterly Report, 1 Jan.–31 Mar. 1965
Eric J. Woodbury Fort Monmouth, N. J., Army Electron. Labs. [1965] 25 p
(Contract DA-28-043-AMC-00326(E))
(Rept.-3; AD-617343)

Tradeoffs between tungsten lamps and xenon flashlamps as pumps for pulsed Nd:YAG lasers are investigated. The results obtained are given in detail and indicate that below 6 kc repetition rate, flashlamps are superior to tungsten lamps while above 6 kc repetition rate the reverse is true. The actual crossover region is not sharply defined so that from 3 kc to 8 kc repetition rate other system considerations could force the choice of one or the other types of lamps. M.R.W.

N65-30541*# General Telephone and Electronics Labs., Inc., Bayside, N. Y. Bayside Labs.
INVESTIGATION OF ELECTRO-OPTICAL TECHNIQUES FOR CONTROLLING THE DIRECTION OF A LASER BEAM. PART I: BEAM DEFLECTOR DEVICES. PART 2: BEAM DEFLECTOR SYSTEMS Interim Report
V. J. Fowler, J. Schlafer, S. Kapuscienski, R. Johnson, and P. Weiss 29 Mar. 1965 76 p
(Contract NAS8-11459)
(NASA-CR-64222; TR-65-722.8) CFSTI: HC $3.00/MF $0.75 CSCL 20E

An investigation of a system for optical acquisition and tracking is described. Part I of the report is concerned with the experimental development of the key component of the system, a laser beam steerer which uses piezoelectrically driven mirrors. Consideration is given to maximum attainable resolution, frequency response, hysteresis, thermal and aging effects, and unwanted models of deflection. Part II deals mainly with the theoretical aspects of the system. This section discusses types of scan modes, range calculations, and noise analysis including combined effects of atmospheric and shot noise. Also described are results of a one dimensional tracking system incorporating shear plate deflectors. Author

N65-30609# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET SEMICONDUCTOR LASER RESEARCH Surveys of Soviet-Bloc Scientific and Technical Literature
22 Jul. 1965 66 p refs
(ATD-P-65-33)

In reviewing Soviet proposals for semiconductor lasers, cyclotron resonance, indirect transition, optically pumped direct transition, and pulsed electric field lasers are discussed. Analysis of the pulsed electric field method for obtaining population inversion; temperature, impurity concentration, and lifetime of excess carriers necessary to obtain population inversion in n-type Ge; and experimental studies are included in a survey of the pulsed electric field laser. Experimental studies and a theoretical analysis are examined for the optically pumped direct transition laser. In discussing semiconductor lasers, p–n junction lasers, conditions for population inversion of electrons in degenerate semiconductors, derivation of oscillation conditions, and the structure of emission spectra from GaAs injection lasers are among the topics included. Theory and analysis of attaining population inversion are also reviewed, and the conversion of laser radiation into electric current is discussed. C.T.C.

N65-30870# Bell Telephone Labs., Inc., Murray Hill, N. J.
SOLID-STATE MASER RESEARCH (OPTICAL) Quarterly Report, 14 Nov. 1964–14 Feb. 1965
J. E. Geusic 14 Feb. 1965 22 p refs
(Contract DA-36-039-AMC-02333(E))
(QR-6; AD-617184)

Part I reports the generation of repetitive, high-power pulses by repeated Q-switching of a continuously pumped YAG:Nd laser. Part II discusses the results of an experimental and theoretical study of Yb^{3+} in yttrium-aluminum and yttrium-gallium-garnet. Author

N65-31013*# Technical Research Group, Inc., East Boston, Mass.
FREQUENCY STABILIZED GAS LASERS. PHASE I: STUDY REPORT
P. Rabinowitz and J. T. La Tourrette Jul. 1965 26 p refs
(Contract NAS8-11773)
(NASA-CR-64359) CSCL 20E

"Gain-dither" laser frequency stabilization has been previously demonstrated with 3.39μ lasers at TRG. The change in parameters necessary to utilize this technique in the visible region of 6328Å are examined through both theoretical and experimental considerations. It is shown that it is necessary to use a 3.39μ laser as an optical pump gain modulator to achieve a satisfactory discriminant for stabilization. With such a pumping scheme, a breadboard stabilization system was constructed. Frequency stability of a few parts in 10^{10} for periods of several minutes was achieved. Conclusions arrived at affecting the design of a stabilized laser package are included. Author

N65-31091# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A MATHEMATICAL MODEL OF A TRAVELING WAVE LIGHT AMPLIFIER IN A TRIANGULAR CONFIGURATION
John Allan Love, III (M.S. Thesis) Jun. 1965 102 p refs
(GSP/PHYS/65-14; AD-616707)

A traveling wave optical maser (TWOM) was placed in a recirculating configuration to make multipass amplification possible. First, a computer analysis was performed to determine the change of the population inversion in the amplifying medium and the output photon flux as the input signal travels through the medium. Specifically, the resulting two coupled rate equations were solved using material-cavity parameters corresponding to neodymium-doped calcium tungstate in a cavity 40 nanoseconds in length. It was found that only under constant high pumping rates and in short cavity path lengths will the returned output energy be amplified again. Second, an experiment was performed utilizing ruby for both the oscillator and the amplifier. Amplification of the order of 30 db occured. Author

N65-31107* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A LABORATORY INVESTIGATION OF TURBULENCE DETECTION USING A LASER
Kent Bourquin and Fred H. Shigemoto *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 53–59 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

Calculations and experiments have been undertaken to determine the property of the backscattered laser-return signal that undergoes the most significant change in a turbulent region as compared with a nonturbulent region. If the turbulent region is composed mainly of air molecules, the detection of a shift in the frequency property appears to be the most promising. Therefore at this time the main effort at the Ames Research Center is focused on the implementation and laboratory evaluation of a clear-air turbulence detector utilizing a laser source and observing the frequency change. Author

N65-31202# Spectra-Physics, Inc., Mountain View, Calif.
HIGH POWER GAS LASER IN THE VISIBLE Quarterly Progress Report, Jan. 1–Mar. 31, 1965
Arnold L. Bloom and Robert L. Byer [1965] 23 p refs
(Contract DA-28-043-AMC-00194(E))
(QPR-3; AD-618106)

Work during this quarter has consisted of spectroscopic investigation of the laser emission from C-W argon, krypton, and xenon lasers and from the pulsed mercury-helium laser. The work with the noble gas ion lasers has indicated widths of 3,000 to 5,000 megacycles, with clearly resolved Zeeman splitting in fields over 700 gauss. The mercury measurements have resolved the isotope shift in the 6150 Å line and indicated a line width of about 500 megacycles. Details of the exact wavelength measurement of the mercury wavelength are presented in this report. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-30193# Michigan Univ., Ann Arbor. Lab. for Fluid and Heat Transport Phenomena.
ULTRASONIC-INDUCED CAVITATION STUDIES IN LEAD-BISMUTH ALLOY AT ELEVATED TEMPERATURES Technical Report No. 2
R. Garcia and F. G. Hammitt Jun. 1965 71 p refs
(Grant NSF G-22529)
(Rept.-05031-2-T)

Cavitation studies have been conducted in lead-bismuth alloy (70% lead, 30% bismuth) at 500° F and at 1500° F with a vibratory device utilizing a piezoelectric crystal transducer unit and high-temperature cavitation facility. Test specimens of various materials were attached to the ultrasonic transducer and vibrated at a frequency of ≈ 18 Kc/sec. with a double amplitude of ≈ 2 mils. The test materials that were subjected to the cavitation environment were 304 stainless steel (U-M), 316 stainless steel (U-M), T-111 (P & W) (Ta-8W-2Hf), T-222(A) (P & W)(Ta-9.5W-2.5Hf-05C), Mo-1/2Ti(P & W), Cb-1Zr (P & W), and Cb-1Zr(A) (P & W). Test duration varied, depending on the amount of damage observed. However, intermittent monitoring of the surface and weightings were conducted until at least the complete face of the specimen was damaged, and the damage rate had become approximately constant. Results are presented. N.E.A.

N65-30246# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
DETERMINING THE THERMAL CONTACT RESISTANCE BETWEEN METAL-CERAMIC SURFACES
V. S. Miller Apr. 1965 10 p refs Transl. into ENGLISH from Zbirnik Prats, Kiev Inst. Teploenerg., Akad. Nauk Ukr. SSR, No. 20, 1960 p 54–59
(RSIC-401; AD-617271)

Experimental investigations were conducted in defining the resistances of thermal contact between flat surfaces of metal–ceramic alloys, and a mixed pair metal to metal–ceramic. Results show that thermal resistance in the zone of contact of metal–ceramic specimens changes, dependent on the strength of pressure and composition of the alloy. The size of the thermal contact resistance of metal–ceramic alloys is two to three times greater than of a steel alloy with the same quality of finish and under the same pressures. With the increase of the coefficient of heat conductivity of metal–ceramic alloys, the size of the thermal resistance decreases. Under exertion of pressure greater than 250 kg per square cm this conformity begins to change. The quality of surface finish has a small influence on the size of thermal resistance. The magnitude of thermal resistances for contacting metal–ceramic to metal is smaller than for metal–ceramic to metal–ceramic. The results show the necessity of including the thermal resistance of contact at marked temperature ranges of parts made from metal ceramic alloys which transmit large heat flows. R.N.A.

N65-30431# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF TECHNOLOGY OF FOUNDRY PRODUCTION Collection of Articles

M. V. Sharova, ed. 3 Mar. 1965 227 p refs Transl. into ENGLISH of the book "Voprosy Tekhnologii Liteynogo Proizvodstva" Moscow, Oborongiz, 1961 p 1–180
(FTD-MT-64-89; AD-617093)

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2. PRESSURE CASTING AND ITS HYDRODYNAMIC BASES V. Ya. Tarutin and Ye. S. Stebakov p 26–48 (See N65-30433 19-15)

3. DEGASSING ALUMINUM-SILICON ALLOYS BY HEXACHLORETHANE M. V. Sharov and O. I. Nikishayeva p 49–80 refs (See N65-30434 19-17)

4. INVESTIGATION OF KINETICS OF OXIDATION OF LIQUID ALUMINUM A. Ya. Radin p 81–111 refs (See N65-30435 19-06)

5. INVESTIGATION OF KINETICS OF OXIDATION OF ALUMINUM ALLOYS IN LIQUID STATE A. Ya. Radin p 112–138 refs (See N65-30436 19-06)

6. FORMATION OF GAS POROSITY IN CASTINGS MADE FROM ALUMINUM-SILICON ALLOYS A. P. Gudchenko p 139–159 refs (See N65-30437 19-17)

7. DETERMINATION OF CONTENT OF HYDROGEN IN ALUMINUM ALLOYS BY METHOD OF VACUUM EXTRACTION A. P. Gudchenko and A. I. Leont'yev p 160–186 refs (See N65-30438 19-06)

8. DETERMINATION OF CONTENT OF HYDROGEN IN MAGNESIUM A. P. Gudchenko and V. V. Serebryakov p 187–199 refs (See N65-30439 19-06)

9. HYDROGEN IN ALLOY ML 5 M. V. Sharov and V. V. Serebryakov p 200–211 refs (See N65-30440 18-17)

N65-30434 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEGASSING ALUMINUM-SILICON ALLOYS BY HEXACHLORETHANE

M. V. Sharov and O. I. Nikishayeva *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 49–80 refs (See N65-30431 19-17)

The influence of hexachlorethane and the amount applied temperatures, range and duration of temperature treatment of the alloys on the intensity of degassing was investigated. The methods are described in detail, and the results are tabulated for AL2 and AL9 alloys. It was concluded that degassing of alloy AL2 by hexachlorethane allowed dense castings from modified alloy independent of the mold material, and was more economical than previously used methods. Also, degassing of AL9 ensures a low content of hydrogen in the melt and dense castings when metallic molds are used. C.T.C.

N65-30437 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FORMATION OF GAS POROSITY IN CASTINGS MADE FROM ALUMINUM-SILICON ALLOYS

A. O. Gudchenko *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 139–159 refs (See N65-30431 19-17)

A study was made of the formation of gas porosity due to hydrogen content in the melt and to cooling speed in casting molds made from aluminum–silicon alloys. The experimental method is described, and the content of hydrogen in the liquid alloy is tabulated. An X-ray analytical investigation established the character and degree of development of gas porosity in the castings. Data showing the influence of composition and duration of crystallization on the magnitude of the minimum gas content are graphically presented. Results showed that the development of gas porosity in the castings depends on composition of the alloy, content of gas in the melt, and intensity of cooling during crystallization. It is concluded that a tendency to formation of porosity is exhibited by alloys containing 6% to 8% silicon; and that alloys near eutectic composition are preferred for obtaining dense castings in conditions of slow cooling during hardening. C.T.C.

N65-30440 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HYDROGEN IN ALLOY ML 5

M. V. Sharov and V. V. Serebryakov *In its* Probl. of Technol. of Foundry Production 3 Mar. 1965 p 200–211 refs (See N65-30431 19-17)

Variations in the solubility of hydrogen in alloy ML5 were determined in the temperature range of 20° to 850° C and with a gas partial pressure of one atmosphere. Coefficients were calculated for the known equation of hydrogen solubility in metals, and change in solubility of hydrogen due to temperature was graphed. The formation of supersaturated solutions of hydrogen in metal is described, and graphs and charts of cooling rates are presented. Studies on the influence of cooling speed during crystallization on the formation of supersaturated solutions of hydrogen in metal showed that gas generation during metal crystallization can be prevented. It was therefore concluded that the formation of gas porosity can also be prevented. C.T.C.

N65-30446# Naval Research Lab., Washington, D. C.

LOW CYCLE FATIGUE CRACK PROPAGATION CHARACTERISTICS OF MONEL 400 AND MONEL K-500 ALLOYS

T. W. Crooker, R. E. Morey, and E. A. Lange 10 Mar. 1965 14 p refs
(NRL-6218; AD-613558)

Tests were conducted on Monel 400 and Monel K-500 plate bend fatigue specimens. Rapid crack initiation was achieved by means of a mechanical surface notch, and crack growth rates were monitored under constant-total-strain-range full-reverse cycling. Test conditions included a variety of strain range values in both air and simulated salt water environments. It was found that low cycle fatigue crack growth rates can be expressed as an exponential function of applied total strain range. Based on this function a method was devised for comparing the low cycle fatigue crack propagation characteristics of a variety of materials. This method takes into account yield strength level, elastic modulus, and the effects of a corrosive environment. Author

N65-30457*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.

HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report No. 2, 23 Jan.–Apr. 1965

J. M. Criscione, J. Rexer, and R. G. Fenish 12 Jul. 1965 28 p refs
(Contract NASw-1030)
(NASA-CR-64205) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Research was conducted on methods of applying iridium to the refractory metal substrate, the chemical and mechanical behavior of the coating substrate system, and qualitative oxidation tests. The rate of interdiffusion of iridium and tantalum is being determined at 1500° C. The rate of increase of the diffusion zone follows a parabolic rate expression. Microbend tests were used to demonstrate the ductility of hot-rolled iridium and iridium on tantalum. As-rolled specimens were bent at an angle greater than 90 degrees without fracture. Annealing of roll-bond iridium–tantalum couples at 1500° C resulted in the formation of

a diffusion zone which cracked under slight loads in the bend tests. A study of tungsten as a diffusion barrier between iridium and niobium showed a reaction zone only at Ir–W interface. Iridium was electrodeposited on tantalum and niobium substrates. The mechanical behavior of electrodeposited iridium was different from that of rolled iridium. The former was brittle when deposited on tantalum and niobium but ductile when deposited on copper. Iridium roll-bonded to tantalum and niobium is ductile. R.N.A.

N65-30477*# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.

A STUDY OF THE ADHESION AND COHESION OF METALS First Quarterly Progress Report, Mar. 9–Jun. 9, 1965

M. J. Hordon and R. P. Giammanco 16 Jul. 1965 29 p refs

(Contract NASw-1168)

(NASA-CR-64117) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Research on the solid state adhesion and cohesion of metals has been conducted at National Research Corporation for the past several years. Since adhesion has been observed for metals and alloys under widely varying conditions, there is a need to distinguish among the effects of the more important variables controlling the bonding mechanism. Past research programs have found that adhesion of both metals and alloys increase with temperature, contact stress and surface cleanliness. This report in particular deals with the adhesion dependency on solid solubility. Author

N65-30500# General Electric Co., Philadelphia, Pa. Missile and Space Div.

THE ROLE OF MULLITE FURNACE REFRACTORIES IN THE GROWTH OF SAPPHIRE WHISKERS

Earl Feingold and A. Gatti Apr. 1965 21 p refs

(Contract NOw-60-0465-d)

(R65SD11; AD-464787)

Under certain conditions, high strength single crystal filaments, or whiskers, of sapphire (α-Al_2O_3) can be grown by a vapor phase reaction when aluminum is heated in a slightly oxidizing atmosphere. When mullite refractories are used in the growth chamber, it is shown that the major source of available oxygen originates from silica constituents. The degradation and consumption of the SiO_2 phase from within the mullite furnace tube are described in detail. The reaction for growing sapphire whiskers by the oxidation of aluminum is postulated to be: $3\ SiO_2(s) + 4\ Al(v) \rightarrow 2\ Al_2O_3(s) + 3Si(s)$, which results from several intermediate reactions. These reactions are also discussed. Author

N65-30529# ARO, Inc., Arnold Air Force Station, Tenn.

PROPERTY INVESTIGATION OF COPPER BASE ALLOYS AT AMBIENT AND ELEVATED TEMPERATURES

Dennis D. Horn and Henry F. Lewis Jul. 1965 44 p refs

(Contract AF 40(600)-1000)

(AEDC-TR-65-72; AD-467015)

An investigation was made to determine the properties of copper base alloys at room and elevated temperatures for high heat flux applications. Literature surveys were conducted to study the properties of copper-beryllium, copper-zirconium, and other commercial grades of copper and copper alloys. These properties were compared with experimental data for copper-zirconium and two alloys of copper-beryllium at temperatures up to 1000° F. The test data indicated that the copper-beryllium alloys can be obtained in large sizes with strength levels comparable to survey property levels, whereas for copper-zirconium it was more difficult to reach tabulated strengths because the effectiveness of cold working was reduced for large size billets. The final selection of an alloy depends upon the requirements of a specific application. Author

N65-30546*# Battelle Memorial Inst., Columbus, Ohio.

DEVELOPMENT OF IMPROVED THERMOELECTRIC MATERIALS FOR SPACECRAFT APPLICATIONS Final Summary Report, 29 Jun. 1964–29 Jun. 1965

E. P. Stambaugh, L. K. Matson, B. G. Koehl, R. Simon, and E. H. Lougher 25 Jun. 1965 56 p refs

(Contract NAS8-11452)

(NASA-CR-64252) CFSTI: HC $3.00/MF $0.50 CSCL 11F

This research was directed towards the study and optimization of selected materials for use in the thermoelectric cooling in a space environment. The materials studied were Bi-Sb alloys in the Ag-Sb-Fe-Te-Se system. Experimental effort was directed toward optimization of n- and p-type Bi-Sb alloys for low-temperature thermoelectric cooling and toward the preparation and evaluation of ternary and quaternary alloys in the Ag-Sb-Fe-Se-Te system for use at higher temperatures. Theoretical work was concerned with the development of useful guidelines in the selection and development of improved thermoelectric materials. N.E.A.

N65-30601# Atomic Energy Commission, Washington, D. C.

CORROSION OF METALLIC MATERIALS BY URANIUM HEXAFLUORIDE AT HIGH TEMPERATURE [CORROSION DE MATERIAUX METALLIQUES PAR L'HEXAFLUORURE D'URANIUM A HAUTE TEMPERATURE]

G. Langlois Nov. 1964 97 p refs Transl. into ENGLISH of CEA Report No. 2385

(AEC-TR-6504; CEA-2385) CFSTI: $4.00

The phenomena of corrosion due to gaseous diffusion of uranium hexafluoride at the plant operating temperature has been studied. Various metallic materials which were subjected to uranium hexafluoride at temperatures ranging from 50° to 700° C showed a high corrosion rate. Corrosion rate was measured by means of changes in electrical resistance. Nickel and monel were deemed satisfactory in resistance to corrosion at temperatures of 450° to 550° C respectively. The penetration of corrosion as well as the velocity of corrosion was also determined. The differences between corrosion and oxidation were outlined with the inherent risk of corrosion in an isotope purification plant being, by far, the greater. W.M.R.

N65-30606# Atomics International, Canoga Park, Calif.

QUENCHING EXPERIMENTS ON TUNGSTEN USING HELIUM II

H. Schultz Oct. 1964 6 p refs Transl. into ENGLISH from Acta Met., v. 12, no. 6, 1964 p 761–762

(AI-TRANS-61)

Quenching experiments were performed on tungsten wire 0.030 mm in diameter prepared from zone melted material. The wire was heated in a helium cryostat about 1 to 2 cm above the helium II level several times to 2700° to 2800° C and slowly cooled until the residual resistance remained constant enough. For quenching the wire was brought to incandescence in helium II and quickly cooled by discontinuing the heating current. In doing so the specimen was separated by a thin gas layer from the surrounding liquid helium II. A sufficient quenching rate was obtained even when the wire was quenched in the helium cryostat by current break 1 to 2 cm above the helium II bath. Results show an exponential dependence of the additional resistance effected by quenching on the reciprocal absolute temperature. The content in metallic impurities was on the order of 1×10^{-6} parts by weight. During initial annealing the residual resistance dropped to 5×10^{-5} impurity atoms per lattice atom. R.N.A.

N65-30637*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
EVALUATION OF HIGH STRENGTH COLUMBIUM ALLOYS FOR ALKALI METAL CONTAINMENT Interim Report No. 2, Jul. 25, 1962–Jul. 10, 1964
L. B. Engel, Jr. and R. G. Frank [1964] 114 p
(Contract NAS3-2140)
(NASA-CR-54226) CFSTI: HC $4.00/MF $0.75 CSCL 11F

Corrosion testing of three high strength columbium alloy reflex capsules containing purified potassium was conducted at 2000° F for 5000 hours in an ultra high vacuum chamber. The condensing rate of the K was approximately 37 ±12 lb/hr/ft^2 at a vacuum in the 10^{-8} range. Preliminary evaluation revealed a slight amount of general corrosion, but when an improved transfer system was used there was no sign of staining after 5000 hr. The improved transfer system resulted in agreement between mercury amalgamation and zirconium-getter methods. No attack of grain boundaries in either weldments or recrystallized sheet was observed in any of the alloys, which were designated as AS-55, Cb-1Zr, and D-43. There was no loss in strength in the AS-55 alloy after exposure to potassium although there was some coalescence of the carbides. There was no mass transfer in either AS-55 or D-43; however; chemical analysis of all three alloys indicates that oxygen is leached from material high in oxygen by the potassium condensate. M.W.R.

N65-30661# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF METALS IN LIQUID AND SOLID STATES Selected Articles
18 May 1965 20 p refs Transl. into ENGLISH from Issled. Metal. v Zhidkom i Tverdom Sostoyaniyakh, (Moscow), 1964 p 241–254
(FTD-MT-65-103; AD-615524)

CONTENTS:

1. KINETICS OF OXIDATION OF ALLOYS OF TUNGSTEN WITH NIOBIUM D. A. Prokoshkin, Ye. V. Vasil'yeva, and I. Yu. Lazareva p 1–8 refs (See N65-30662 19-17)
2. PROPERTIES OF TERNARY ALLOYS OF NIOBIUM WITH TANTATUM AND MOLYBDENUM Ye. V. Vasil'yeva and D. A. Prokoshkin p 9–16 refs (See N65-30663 19-17)

N65-30662 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
KINETICS OF OXIDATION OF ALLOYS OF TUNGSTEN WITH NIOBIUM
D. A. Prokoshkin, Ye. V. Vasil'yeva, and I. Yu. Lazareva *In its* Invest. of Metals in Liquid and Solid States 18 May 1965 p 1–8 refs (See N65-30661 19-17)

The oxidation kinetics of binary alloys of tungsten with niobium was investigated to 50% Nb. Oxidation was produced by continuous suspension of the alloys in open air at 900° to 1300° C. The scale of the alloys was examined by X-ray and chemical analysis. The oxidation kinetic curves are shown for pure tungsten and the binary alloys. It is shown that the kinetics are characterized by considerable deflection from parabolic law and by approximation to linear law. At 1300° C in alloys with 15%, 20%, and 30% Nb, a transition to parabolic law was observed. A similar phenomenon occurs also in unalloyed tungsten at 1200° C. Alloying with niobium increases the melting point of the oxide scale. The greatest oxidation resistance at all temperatures is possessed by the 30% Nb alloy. The rate of oxidation was found to be determined basically by structural transformations in the oxide scale. A considerable role is also played by physico-mechanical properties of the oxide scale varying in the course of its sintering at high temperatures.
E.E.B.

N65-30663 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPERTIES OF TERNARY ALLOYS OF NIOBIUM WITH TANTALUM AND MOLYBDENUM
Ye. V. Vasil'yeva and D. A. Prokoshkin *In its* Invest. of Metals in Liquid and Solid States 18 May 1965 p 9–16 refs (See N65-30661 19-17)

A binary alloy of niobium with 10% molybdenum was alloyed with tantalum from 0.25 to 15% tantalum. This ternary system was then investigated and the results compared with unalloyed niobium and a niobium alloy containing 5% molybdenum and 10% tantalum. The microstructure was studied in cast and annealed samples. Also, specific weight, oxidation resistance, and hardness was determined. It was found that small additions of tantalum to the binary alloy lowers the rate of its oxidation at temperatures from 1000° to 1200° C. With further increase of tantalum, oxidation resistance continues to increase to 5% tantalum. At 5% tantalum and above, the rate of oxidation increases; however, the rate remains lower than for unalloyed niobium. A sample of Nb-10Mo-15Ta was completely oxidized in 21 hours. Relatively good oxidation resistance was observed by an alloy containing 5% Mo and 10% Ta. E.E.B.

N65-30673# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
STUDIES OF CARBON-CONTAINING MARTENSITIC STEELS FOR AN HY-180/210 WELDMENT
D. S. Dabkowski, S. J. Manganello, and L. F. Porter 1 Mar. 1965 44 p refs
(Contract NObs-88540)
(S-21102; S-21103-1; AD-616928)

Initial studies to develop an HY-180/210 steel suggested a number of approaches by which carbon-containing martensitic steels might be improved to meet the objective of a minimum yield strength of 180 ksi and a Charpy V-notch energy absorption of 50 ft-lb at 0 F. During the past year, a series of follow-up studies was undertaken on 3 to 9 percent nickel quenched and tempered steels. The studies involved an investigation of the effects of variation in carbon content, strengthening through the addition of cobalt, and secondary hardening through the addition of vanadium, tantalum, columbium, tungsten, titanium, and aluminum. Author

N65-30692# Hydronautics, Inc., Laurel, Md.
INTENSITY OF CAVITATION DAMAGE ENCOUNTERED IN FIELD INSTALLATIONS
A. Thiruvengadam Feb. 1965 32 p refs
(Contract Nonr-3755(00))
(TR-233-7; AD-464806)

A nomogram called "Cavitation Damage Intensity Estimator" is presented for estimating cavitation damage intensities of field installations. This simple approach is based on an earlier definition of cavitation damage intensity as the power absorbed per unit area of the eroded material. Using this estimator and the data published for field installations, the damage intensity is estimated for ships' appendages, ships' propellers, valves, Diesel engine cylinder liners, hydraulic turbine runners and pumps. These estimates show that the intensities for propellers and valves can be several orders of magnitude higher than that for laboratory test devices. A summarized analysis shows the field experience and laboratory experience in the proper perspective in terms of their intensities. The possible usefulness of various protection methods are projected for various intensity levels. The threshold intensity of cavitation damage is found to be proportional to the endurance limit of metals. Author

N65-30697*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MATERIAL DAMPING OF ALUMINUM BY A RESONANT-DWELL TECHNIQUE
Neal Granick and Jesse E. Stern Washington, NASA, Aug. 1965 25 p refs
(NASA-TN-D-2893) CFSTI: HC $2.00/MF $0.50 CSCL 11F

At intermediate and high stress levels, material damping has been considered stress-amplitude-dependent and contributions from frequency-dependent anelastic mechanisms have been considered negligible. These considerations are contradicted by the findings of this investigation for Aluminum 2024-T4. The relations between material damping, stress amplitude, and frequency were experimentally examined for this material by means of a resonant-dwell technique employing "identical" double cantilever reeds. Tests were run in air (760 mm, 70° F), and in vacuum (0.2 mm, 70° F), at stress amplitudes up to 20,000 psi and at frequencies from 15 to 1500 cps. Results showed that: damping as measured in air was largely aerodynamic drag and was displacement-amplitude and frequency dependent; damping as measured in vacuum was wholly material damping, independent of stress amplitudes up to 20,000 psi, and dependent on frequency; and there was agreement with the Zener theory of thermal relaxation. Author

N65-30709# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF DIFFUSION OF INTERSTITIAL ATOMS IN ORDERED ALLOYS OF THE CuPt TYPE
M. I. Dekhtyar 12 May 1965 15 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 8, no. 2, 1963 p 183–190
(FTD-TT-65-28/1+2; AD-467000)

The dependence of the diffusion coefficient of CuPt type alloys on the degree of long-range order, the direction of the concentration gradient of interstitial atoms in the interstitials of admixture atoms, and the temperature and the composition of the alloy are considered. It is shown that ordering may lead to a considerable change in the value of the diffusion coefficient and,the appearance of pronounced anisotropy. Certain relationships between the jumps of effective energy activation during the transition of alloys to the ordered state may be checked experimentally. Author

N65-30723*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RESEARCH ON FIBER-REINFORCED COMPOSITES
J. Chorne, W. H. Sutton, A. Gatti, R. Mehan, H. Rauch et al May 1965 28 p refs Presented at Refractory Composites Working Group 10th Meeting, Georgia Inst. of Technol., Atlanta, 12–14 Apr. 1965
(Contracts NAS2-937; NOw-64-0540-c; DA-19-0660-AMC-184(X); AF 33(615)-1696; AF 33(615)-1618 et al)
(NASA-CR-64087; R65SD18; AD-615662) CFSTI: HC $2.00/MF $0.50 CSCL 11D

This paper considers the practical possibilities of the use of radar to determine the amount of water falling into a catchment during a given time period and in measuring precipitation over the sea. There are two basic methods of making quantitative radar rainfall measurements. One of these relates the intensity of the echo received from the rain to the rate of rainfall. If Plan Position Indicator (PPI) scanning is used and the signals can be integrated over an area and period of time then this method should provide measurement of a real rainfall. The alternative method depends on the fact that at certain wavelengths the attenuation of a radar signal as it passes through rain can be related to the mean rate of rainfall along the path. If the attenuation could be measured along several fairly closely spaced paths then it might be possible to estimate the rainfall over an area. This paper discusses the various factors which limit the accuracies of both these measurements and describes how a radar might be developed so as to register automatically the rainfall amount over a chosen area. N.E.A.

N65-30757# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
THE RULE OF CARBON AND FINE STRUCTURE IN THE HARDENING OF IRON-NICKEL-CARBON MARTENSITES Technical Report No. 10
Marc H. Richman (Brown Univ.) and Morris Cohen 27 Apr. 1965 32 p refs
(Contract Nonr-1841(35))
(DSR-7618)

The internal twins in iron-nickel and iron-nickel-carbon martensites have been measured by transmission electron microscopy under a number of conditions. The mean twin thickness is 57 ±5Å, and the mean twin spacing is 97 ±5Å, independent of the carbon content, M_s temperature, and whether the martensite is formed althermally or isothermally (by electrolytic thinning of the specimen). The ratio of these two parameters is in line with that predicted for an invariant-plane transformation, indicating that the internal twins come into existence as an integral part of the martensitic transformation. Notwithstanding the constancy of the twin dimensions, the hardness of these martensites increases in the usual way with carbon content. Hence, a solid-solution hardening model is proposed to account for the carbon-dependent strengthening of virgin martensite. A reasonable explanation is obtained through interactions between dislocations and random carbon atoms, assuming a parabolic-hyperbolic potential well and an interaction energy of 0.5 eV. Author

N65-30832*# Lockheed Missiles and Space Co., Palo Alto, Calif. Materials Sciences Lab.
EVALUATION OF Be-38% Al ALLOY Final Report, 27 Jun. 1964–28 Feb. 1965
Raymond W. Fenn, Jr., W. C. Coons, Donald D. Crooks, Alfred S. Neiman, John Robinson et al 28 Feb. 1965 108 p refs *Its* Rept.-8
(Contract NAS8-11448)
(NASA-CR-64343) CFSTI: HC $4.00/MF $0.75 CSCL 11F

Detailed studies were made on six heats of Be-38% Al alloy in the annealed temper to determine the level and reproducibility of mechanical properties, the microstructural features, preferred orientations, and the general metallurgical quality of the metal. Data reported include: Young's modulus, tensile, compressive, shear, bearing and bend properties at temperatures between −320° and 800° F; tensile properties at 75° F after exposure to 400° or 800° F for 10, 100, and 1000 hr; representative photomicrographs; and pole figures [viz: Be (0002), Be (10$\bar{1}$1) and Al (111)]. Average longitudinal properties at 75° F for the material studied are presented. Mechanical property data are summarized in Tables I and II. Author

N65-30848*# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
EFFECTS OF HYDROSTATIC PRESSURE CYCLING ON THE MECHANICAL BEHAVIOR OF BODY CENTERED CUBIC REFRACTORY METALS AND ALLOYS Interim Technical Report No. 2
G. Das and S. V. Radcliffe [1965] 25 p refs
(Grant NsG-654)
(NASA-CR-64317) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The effects of second phase morphology on the terminal substructures developed in iron-carbon alloys subjected to high hydrostatic pressures have been examined for a quench aged condition. Some analogous loop formation by differential thermal contraction during quenching was observed at spherical particles of excess carbide. Measurements of the influence of pressure on the terminal ductile-brittle transition temperature of annealed powder-metallurgy tungsten wire of commercial purity have shown that the tensile transition temperature is reduced by some 50° C after a pressure cycle to 13 kilobars. In order to characterize the structure of molybdenum for pressure cycling studies, annealed sheet specimens of a commercial purity molybdenum prepared from (a) powder metallurgy and (b) arc-cast material from the same supplier have been examined by transmission microscopy. Continuum elasticity calculations of the stress fields developed around smooth spherical particles contained in a matrix subjected to external hydrostatic pressures indicate that the stress concentration developed at the particle-matrix interface is less than that required for nucleation of dislocations. Author

N65-30866# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLUXES FOR MECHANIZED ELECTRIC WELDING

V. V. Pidhaets'kiy 2 Apr. 1965 93 p refs Transl. into ENGLISH of "Flyusi Dlya Mekhanizovanogo Elektrozvaryuvannya" Kiev, Izd. Tekhn. Lit. Ursr, 1961 136 p
(FTD-TT-64-1252/1+2; AD-617092)

This booklet outlines various methods of mechanized welding in which fluxes are utilized. The role played by the flux in these welding methods is elucidated. Existing fluxes are classified according to their technique of preparation, their use, and other characteristics. The main emphasis is placed on the description of fluxes used at home and abroad in arc welding and electroslag welding of steels and light metals. Details are given of the technique of preparation of fused fluxes, ceramic fluxes, and agglomerated fluxes. The booklet is intended for engineering-technical workers of the machine-building, ship-building and other branches of industry, as well as building-construction enterprises. Author

N65-30869# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE WEAR RESISTANCE OF ENAMEL COATINGS

G. I. Belyayev and S. M. Ponomarchuk 12 May 1965 10 p refs Transl. into ENGLISH from Khim. Mashinostr. (USSR), no. 2, 1964 p 30–32
(FTD-TT-65-23/1+2; AD-617145)

Various enamel coatings were tested for their resistance to wear in a revolving drum filled with an abrasive, acid quartz sand. Hardness was determined by the loss of weight. Enamels with high aluminum and titanium dioxide content showed good resistance to abrasive wear, and additions of zirconium, feldspar, chromium oxide, electrocorundum, or quartz sand improved the wear resistance of enamel coatings even further. Increased hardness and refractory material additions to the enamel dross necessitated higher firing temperatures up to 1000° C for a period of 5 minutes to insure good fusion of the coatings. G.G.

N65-30915# United States Steel Corp., Monroeville, Pa. Applied Research Lab.

STRESS-CORROSION BEHAVIOR OF 12 PERCENT NICKEL MARAGING-STEEL WELDMENTS

A. W. Loginow 31 Dec. 1964 20 p
(Contract NObs-88540)
(S-23309; AD-616982)

As part of the Applied Research Laboratory's program to determine the feasibility of developing an HY-180/210 weldment, studies were conducted to determine the stress-corrosion properties of 12Ni-5Cr-3Mo maraging-steel weldments in marine environments. Stress-corrosion tests were conducted with welded U-bend specimens in quiescent and flowing sea water, in the tidal zone, and in a marine atmosphere. Stress-corrosion cracking was observed in specimens exposed in the three seawater environments in 6 to 17 days; no significant difference in cracking time was observed among the environments. In the marine atmosphere the specimens showed an appreciably higher resistance to stress-corrosion cracking; the shortest cracking time in this environment was 62 days. Metallographic examination showed that, generally, the cracks initiated in the weld metal and propagated in the weld metal and in the heat-affected zone. The absence of base-metal cracking (away from welds) in some specimens exposed for 170 days is regarded as evidence that the base metal may be resistant to cracking in marine environments. It also appears that carbon steel can prevent cracking by cathodically protecting 12Ni-5Cr-3Mo weldments. Author

N65-30925# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE INTERNAL FRICTION OF POWDER-METALLURGICAL WC–Fe, WC–Ni AND WC–Fe–Ni ALLOYS

Ke Sun Chung 21 May 1965 6 p Transl. into ENGLISH from Chosun Kwahakwon Tongbo (Korea), no. 1, 1962 p 8–9
(FTD-TT-64-1001/1+2+3+4; AD-466485)

The internal friction patterns of powdered metals and alloys, in particular the mechanism of internal friction peaks due to crystal and atom imperfections at the boundaries of metal particles, were investigated. The light alloys used were WC–Fe, WC–Ni, and WC–Fe–Ni. Three internal friction peaks were found on the internal friction versus temperature curves for the first two alloys and five peaks were found for the latter alloy. Explanations are given for the occurrence of each peak. As the contents of Fe and Ni were increased, the level of the curve of internal friction versus temperature descended. This is believed to be due to the formation of a homogeneous solid solution. When the internal friction was measured after subjection to compression, the overall level of the background curve of internal friction rose. No new friction peaks or shifting of peak positions were observed which suggests that the occurrence of internal friction is not related to the deformation process. R.N.A.

N65-30961*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OPTIMIZATION OF TIME-TEMPERATURE PARAMETERS FOR CREEP AND STRESS RUPTURE, WITH APPLICATION TO DATA FROM GERMAN COOPERATIVE LONG-TIME CREEP PROGRAM

Alexander Mendelson, Ernest Roberts, Jr., and S. S. Manson Washington, NASA, Aug. 1965 36 p refs
(NASA-TN-D-2975) CFSTI: HC $2.00/MF $0.50 CSCL 11F

By the use of orthogonal polynomials developed for discrete sets of data, the least-squares equations for determining the optimized stress-rupture parametric constants are obtained in nearly uncoupled form; thus the use of high-degree polynominals is permitted without the loss of significant figures. Optimum values of the constants can thereby be accurately obtained. The method is applied to the data obtained from the German cooperative long-time creep program by using a general parameter of which the Manson-Haferd and Larson-Miller parameters are special cases. Good correlation was

obtained. An analysis is also made of creep data obtained for columbium alloy FS-85 with good results. A complete Fortran IV computer program is included to aid those wishing to use the method. Author

N65-30990# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
DEVELOPMENT OF AN HY-130/150 WELDMENT Progress Report No. 6
L.F. Porter, A. M. Rathbone, S. T. Rolfe, W. T. De Long, K. E. Dorschu et al 1 Mar. 1965 32 p refs
(Contract NObs-88540)
(S-10000-6; AD-616932)

Final laboratory composition studies showed that the standard 5Ni-Cr-Mo-V steel can meet the mechanical-property requirements for an HY-130 base metal in plates through 6 inches thick. A fourth 80-ton electric-furnace heat of the 5Ni-Cr-Mo-V steel has been produced, and the mechanical properties of plates confirm the predictions indicated by the final laboratory composition studies. Plates from this fourth heat are being shipped to participants in the weldment-evaluation program so that the program can be initiated shortly. The laboratory development of the Air Reduction 2Mn-2Ni-Cr-Mo MIG filler metal is essentially completed. Evaluation of this filler metal indicates that the properties of the weld metal, including those of weld metal deposited out-of-position, meet the requirements for an HY-130 weldment. Consequently a 20-ton heat of the 2Mn-2Ni-Cr-Mo filler metal has been produced. Evaluation of the production material will be completed shortly, and the wire will then be distributed for fabrication of the weldment-evaluation test specimens. Author

N65-30993 Joint Publications Research Service, Washington, D. C.
HEAT TREATMENT OF TITANIUM ALLOYS —β PHASE TRANSFORMATION
Chi-min Wang and Lung-tao Ku *In its* Transl. on Communist China's Sci. and Technol., No. 202 9 Aug. 1965 p 32–52 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 5, May 1965 p 425–434 (See N65-30991 19-34) CFSTI: $4.00

Titanium alloys of the β-phase were studied for their decomposition transformation dynamics under heat. Major products of the β-phase decomposition are the α-phase, the ω-phase (metal chemical compounds), and the α'-phase. Heating caused concentration of atoms in the β area and subsequent division into two parts. The lower part easily changed into the ω-phase and affected the formation of metal compounds. A small amount of oxygen disturbed the stability of the α-phase. G.G.

N65-31070# Centre de Recherches Metallurgiques, Chambery (France).
RESEARCH ON ZIRCONIUM ALLOYS
R. Syre, J. Orsag, A. Guilhaudis, M. Croutzeilles, R. Bourbon et al Brussels, EURATOM, 1965 158 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-067-62-4 RDF)
(EURAEC-1270; EUR-2074.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 200 Belg. Fr.

This study reviews the so-called active eutectoid alpha alloys of zirconium containing vanadium or nickel additions and in which hardening is brought about by rapid breakdown of the beta phase and appearance of the fine dispersed compounds ZrV_2 or Zr_2Ni as well as by the addition of soluble elements such as aluminum, titanium or tin in the alpha phase. The main results obtained may be summarized as follows: (1) the compound Zr_2Ni does not cause any substantial hardening, (2) the compound ZrV_2 has a much more intensive hardening effect and its study has reached a more advanced stage, (3) aluminum and titanium proved highly deleterious from the standpoint of resistance to corrosion in steam, (4) the ternary addition of tin up to contents of 4 wt.% leads to good mechanical properties in both the cold and the hot state up to 500° C and good thermal stability after 3,000 hours at 500° C, and (5) the correction of the Zr–V–Sn alloys in water or steam depends on the distribution of the compound ZrV_2 in the matrix and on the test temperature. At 350° and 400° C, the corrosion rate remains above that of Zircaloy-2. At 480° C, the oxide layer remains appreciably more adherent. The hydrogen pickup rate during corrosion is about one fifth of that observed in Zircaloy-2. Author

N65-31073# Eidgenossische Technische Hochschule, Zürich (Switzerland).
THE GRAPHITIZATION OF CAST IRON [DIE GRAPHITIERUNG VON GUSSEISEN]
Edward Fot (Ph.D. Thesis) 1964 36 p refs
(Prom.-3549)

Electrochemical corrosion and softening of cast iron in watery solutions of sodium and potassium sulfates and chlorides was investigated. It was found that: (1) Corrosion speed is constant. (2) Perlitic and ferritic cast iron corrode in water or dissociating electrolytic solutions. (3) The pH value of the corroding medium determines the corrosion speed. (4) A high oxygen content of the corroding medium increases the deposition of corrosion products. (5) Corrosion starts with the graphite components of cast iron. (6) A high carbon content in cast iron increases the speed of graphitization. (7) The forming of a porous surface corrosion layer slows corrosion attack somewhat. Experiments proved that a slightly graphitized, moist cast iron surface, that had been exposed to air for a few hours, formed a potent, corrosion curbing surface layer. Transl. by G.G.

N65-31123* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ASSESSMENT OF A TITANIUM ALLOY FOR SUPERSONIC TRANSPORT OPERATIONS
George J. Heimerl and Herbert F. Hardrath *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 215–226 *refs* (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

An assessment is given of the materials problems and implications regarding the use of Ti-8Al-1Mo-1V alloy sheet for the skin of a supersonic transport. Although the assessment of this alloy in the duplex annealed condition is generally favorable, several questions remain unanswered and new ones continue to arise. The seriousness of the salt stress corrosion problem at 500° F and above under flight conditions cannot be predicted on the basis of current laboratory corrosion tests. A new potential stress corrosion problem at ambient temperatures in the presence of cracks and salt water requires investigation. The ability to withstand a 30,000-hour exposure at 550° F without undue degradation of the material or welds will remain doubtful until more long-time data are available. The substitution of a more corrosion-resistant and stable titanium alloy in the tension critical areas of the structure may prove advisable. Author

N65-31156# National Lead Co. of Ohio, Cincinnati.
GAMMA RADIOGRAPHY OF URANIUM METAL
B. L. Twitty and H. W. Humphrey 28 Sep. 1964 12 p
(Contract AT(30-1)-1156)
(NLCO-926)

The techniques and equipment used at the National Lead Company of Ohio for the gamma radiography of uranium metal are described along with procedures for handling specimens of various thicknesses. The present gamma ray source is 15 curies of cobalt-60. In addition to gamma radiography, autoradiography (using the natural radiation of uranium itself as a source of gamma rays), radiography in color, and neutron radiography are discussed. The two latter techniques are relatively new and are still in the development stages. Author

N65-31174# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
COMPOSITION REFINEMENT STUDY—5Ni-Cr-Mo-V STEEL
S. J. Manganello, L. F. Porter, R. J. Sitko, and B. K. Stewart 1 Mar. 1965 73 p
(Contract NObs-88540)
(S-11501; AD-616925)

Studies to date have shown that a 0.10 C, 0.75 Mn, 5.0 Ni, 0.55 Cr, 0.55 Mo, 0.07 V steel is very promising as an HY-130/150 steel. However, the minimum yield-strength range (130 to 150 ksi) and the plate-thickness range of modifications to meet the full range of HY-130/150 requirements. Therefore, the yield-strength and thickness requirements were broken down into four classes: 130 to 145 ksi through 3 inches, 140 to 155 ksi through 3 inches, 130 to 145 ksi in 3 through 6 inches, and 140 to 155 ksi in 3 through 6 inches; and a statistically designed program was initiated to determine the changes in the manganese, nickel, chromium, and molybdenum contents of the 5Ni-Cr-Mo-V steel that would be needed to meet the various requirements. Further examination of the results of the present study on Laboratory steels indicates that the best combination of strength and toughness is achieved when the manganese is decreased and the nickel is increased. Author

N65-31175*# Battelle Memorial Inst., Columbus, Ohio.
THE PREPARATION AND EVALUATION OF HIGH-PURITY, FINE-GRAINED TUNGSTEN AND TUNGSTEN ALLOY CASTINGS Summary Report
S. G. Nelson and E. L. Foster, Jr. 9 Jul. 1965 34 p
(Contract NAS3-6279)
(NASA-CR-54374) CFSTI: HC $2.00/MF $0.50 CSCL 11F

A technique was developed for the preparation of high-purity, cylindrical castings of high-melting-point materials. Relatively fine-grained, 3/4-inch-diameter, tungsten and tungsten-tantalum, -rhenium, -iridium and -osmium alloy castings were prepared by this technique. Most castings contained less than 50 ppm total impurities as determined by mass-spectrographic, gas, and conductometric analyses. Author

N65-31176*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DETERMINATION OF THE WELDABILITY AND ELEVATED TEMPERATURE STABILITY OF REFRACTORY METAL ALLOYS Seventh Quarterly Report, Dec. 21, 1964–Mar. 20, 1965
G. G. Lessmann and D. R. Stoner [1965] 59 p refs
(Contract NAS3-2540)
(NASA-CR-54434; WANL-PR(P)-007) CFSTI: HC $3.00/MF $0.50 CSCL 11F

The weldability and long time elevated temperature stability of refractory metal alloys to determine those most suitable for use in advanced alkali-metal space electric power systems are under study. The post weld annealing series were completed for tantalum and columbium alloys with the exception of yttrium. Three one-hour post weld annealing temperatures in the stress relief-recrystallization range were chosen for columbium alloys 1900° F, 2200° F, and 2400° F and for tantalum alloys 2400° F, 2700° F and 3000° F. Ductility as measured by the bend ductile-to-brittle transition temperature was used to measure weld response to annealing. Chemical analysis data for carbon, oxygen, and nitrogen pick-up in eighteen TIG welds were obtained and reviewed. No apparent contamination occurred during welding. R.W.H.

N65-31177*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DEVELOPMENT OF DISPERSION STRENGTHENED TANTALUM BASE ALLOY Fifth Quarterly Report, Nov. 20, 1964–Feb. 19, 1965
R. W. Buckman, Jr. [1965] 35 p refs
(Contract NAS3-2542)
(NASA-CR-54462; WANL-PR(Q)-006) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Development of dispersion strengthened tantalum base alloys for use in advanced space power systems continued with selection of the sheet and tubing alloy composition Ta-9W-1Re-0.7Hf-0.025C for detailed evaluation. Scale-up of this composition to a four-inch diameter ingot was initiated. Selection of seven additional compositions in the Ta-Mo-Re-W-Hf-Zr-C-N system were made to further optimize the Ta-5.7W-1.56 Re-0.7 Mo-0.25 Hf-0.13 Zr-0.015C-0.015N alloy. Response to heat treatment investigation continued and carbides and nitrides were shown to be stable in the tantalum alloy matrix at temperatures up to 1250° C and at pressures of 10^{-10} torr for 500 hours. Author

N65-31209# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
BERYLLIUM—REVIEW OF RECENT DEVELOPMENTS
Hugh D. Hanes 11 Aug. 1965 4 p refs

Recent developments in beryllium metallurgy are presented. These include physical metallurgy, purification, mechanical properties, fabrication, and applications. C.T.C.

N65-31247# Joint Publications Research Service, Washington, D. C.
ALLOYING ELECTRIC STEELS
B. Kh. Khan and N. Ya. Ishchuk 25 Aug. 1965 20 p refs
Transl. into ENGLISH of the book Raskisleniye, Degazatsiya, Legirovaniye Stali (Moscow), 1965 p 232–246
(JPRS-31707; TT-65-32202) CFSTI: $1.00

Advances in the technology of smelting high-alloy high-strength steels by the electric arc process are reviewed. Discussed are the mixing of the metal with slag during the overflow of the melt; the amount of gaseous oxygen to be used; the amounts and types of alloying material additions to be added; the carbon concentration, chromium, silicon, sulfur, tungsten, and other contents; reducing agents; temperature; and other variables. Graphs are presented showing the change in content of chromium, carbon, and phosphorous in the metal during blowing of the bath with oxygen; the dependence between the residual content of chromium in the slag and the basicity of the slag during the blowing period after its deoxidation; and the dependence of the chromium/carbon ratio (at the end of oxygen blowing the bath) on the temperature for different contents of ferrous oxide in the slag. Frequency curves for distribution of temperature by sulfur are given. The distribution of smeltings in accordance with phosphorous content during the smelting with and without oxygen are tabulated. Other technological aspects of the process are also discussed. L.S.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-30397# General Dynamics/Astronautics, San Diego, Calif.
THE DETERMINATION OF THE VOID CONTENT OF PLASTIC COMPOSITES
M. D. Campbell. 31 Dec. 1964. 15 p. refs
(GD/A-ERR-AN-593)

A method of mixtures approach to the experimental determination of the void contents of plastics and plastic composites is presented. Experimental procedures, calibration, and comparison with theoretical values are discussed. Author

N65-30460*# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF MATERIAL SPECIFICATIONS AND QUALIFICATIONS OF POLYMERIC MATERIALS FOR THE JPL SPACECRAFT MATERIALS GUIDEBOOK. II: RTV SILICONE ADHESIVES AND POTTING COMPOUNDS Special Report No. 2
Judith A. Black, Donald J. Lyman, and Dean B. Parkinson. 1 Jul. 1965. 37 p. refs. Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-64208) CFSTI: HC $2.00/MF $0.50 CSCL 11I

Five RTV* silicone potting compounds and four RTV* silicone adhesive/sealants were selected for study under simulated space conditions. Outgassing characteristics of these materials were determined at 150° C and 5×10^{-6} mm Hg. Outgassed condensable materials were analyzed by infrared spectroscopy; and any visual changes such as sample darkening and softening were noted. Under these conditions, each RTV silicone material evolved large amounts of condensable oil, although the appearance and properties of the test specimens remained unchanged. The oil was identified by infrared spectroscopy as low molecular weight silicone oils of the same chemical type as the RTV compound itself. Author

N65-30504# Naval Ordnance Lab., White Oak, Md. Non-Metallic Materials Div.
THERMODYNAMIC PROPERTIES OF POLYVINYLIDENE CHLORIDE
Robert W. Warfield and M. C. Petree. Aug. 1965. 15 p. refs
(NOLTR-65-86; AD-466679)

Using published specific heat data, the entropy, enthalpy and Gibbs free energy of polyvinylidene chloride (PVdC) have been calculated over the temperature range 0° to 200° K. Using previously published data on the thermodynamic functions of vinylidene chloride, the entropy of polymerization at 200° K was found to be 21.17 cal/mole deg and the free energy of polymerization was −10.1 kcal/mole. The thermodynamic function Cp/T versus T for PVdC is approximately linear with zero slope over the temperature range 0° to 200° K. The thermal motions of PVdC at low temperatures have been studied using the model of Stockmayer and Hecht. By means of this model, the maximum frequency of vibration was found to be about 459 cm^{-1} and the average molecular weight of the repeating unit to be 38.3 gms/mole. Author

N65-30506# Princeton Univ., N. J. Frick Chemical Lab.
THE RELATIONSHIP BETWEEN STRESS RELAXATION AND CREEP
J. J. Aklonis and A. V. Tobolsky. Jun. 1965. 25 p. refs
(Contract Nonr-1858(07))
(RLT-88; AD-465689)

The relationship between stress relaxation and creep is investigated with the aim of mathematically converting between the two types of data. The stress relaxation master curves of five monodisperse polystyrenes are converted to creep master curves using a good approximation for the numerical evaluation of a convolution integral. Master curves generated by analytic functions are used as experimental data to investigate the behavior of creep and stress relaxation curves as the slope in the transition region changes. It is found that large changes in the slopes of stress relaxation master curves are reflected as minute slope changes in creep master curves under some conditions. It is pointed out that while systems with a narrow distribution of relaxation times and a Maxwell body are almost identical in creep, they should be easily distinguishable in stress relaxation. Author

N65-30539*# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF MATERIAL SPECIFICATIONS AND QUALIFICATIONS POLYMERIC MATERIALS FOR THE JPL SPACECRAFT MATERIALS GUIDEBOOK. I: EPOXIDE ADHESIVES Special Report No. 1
Judith A. Black, Donald J. Lyman, and Dean B. Parkinson. 15 Jun. 1965. 55 p. refs. Prepared for JPL
(Contracts NAS7-100; JPL 950745)
(NASA-CR-64232) CFSTI: HC $3.00/MF $0.50 CSCL 11A

The outgassing characteristics of nine epoxide adhesives were determined at 150° and 200° C at 10^{-6} mm Hg. Outgassed materials were analyzed by infrared and mass spectroscopy, and visual changes such as sample darkening and softening were noted. In thermal vacuum tests of these adhesives, little change was observed at 150° C, but at 200° C there were large changes in the outgassing characteristics for most materials and in several cases unambiguous evidence of polymer degradation. The thermal vacuum performance for each adhesive tested is presented. Purity and thickness were found to be important factors in determining outgassing characteristics. R.N.A.

N65-30589# Central Lab. TNO, Delft (Netherlands).
MECHANICAL PROPERTIES OF HIGHLY FILLED ELASTOMERS Technical Report No. 4
H. W. Bree, F. R. Schwarzl, and L. C. E. Struik. Jul. 1965. 90 p. refs
(Contracts N62558-4375; N62558-3884)
(CL/65/58)

Polyurethane–sodium chloride composites were prepared with filler contents between 0 to 70 per cent, by volume. Filler sizes ranged between 1 μm and 300 μm. Tensile creep properties of materials containing single filler fractions in amounts up to 50 per cent, by volume were determined under various constant tensile stresses until rupture. The shape of the tensile creep compliances could be related to the growth of vacuoles in the material. The growth manifested itself in the occurrence of a de-wetting transition in the creep compliance. Rupture mostly occurred before de-wetting was complete. The relationships between the shape and position of the de-wetting transition and stress level, size and content of filler are discussed. Some of these relations may be understood qualitatively, others not yet. Amongst the latter is the remarkable fact that de-wetting strength increased considerably with decreasing filler size. There was a definite reinforcing action of the filler fractions with a size between 1 μm and 40 μm. Author

N65-30648# Joint Publications Research Service, Washington, D. C.
ON THE PIEZO-OPTICAL EFFECT IN POLYMERS UNDER SIMPLE LOADING
I. I. Bugakov 9 Aug. 1965 28 p refs Transl. into ENGLISH from Issled. po Uprugosti i Plastichnosti (USSR), 1964 p 172–191
(JPRS-31470; TT-65-31966)

The piezo-optical properties of a transparent isotropic polymer subjected to a small deformation (in a mechanics sense) is discussed. The deformation does not necessarily have to be elastic. General mathematical relationships are derived for the dependence of dielectric permeability and optical values on the strain and deformation for simple loading, where the components of the strain deviator change in proportion to a single parameter while the principal directions remain constant. These relationships are checked and considered from the standpoint of actual applications. Experimental data is used. Uniform and non-uniform loading cases are considered. L.S.

N65-30664# Naval Research Lab., Washington, D. C.
PHOTODEGRADATION OF HIGH POLYMERS. PART VI: PHOTOLYSIS OF POLYSTYRENE FILMS IN VACUUM AND IN AIR
R. B. Fox, L. G. Isaacs, F. E. Saalfeld, and M. V. Mc Dowell 16 Jun. 1965 18 p refs
(NRL-6284; AD-617952) CFSTI: $1.00

Thin films of polystyrene have been photolyzed by 2537A radiation in vacuum and in air at 25°, 80°, and 120° C. Random scission and crosslinking occur simultaneously, with oxygen acting to inhibit the latter process. Crosslinks exceed scissions in vacuum, and no reduction in viscosity is observed; the ratio of crosslinks to scissions increases with temperature in the 25° to 120° C range. Hydrogen appears to be the major volatile product emanating from the polymer itself. Of the remaining volatile products, carbon monoxide, carbon dioxide, and methane probably arise from polymer imperfections; benzene and monomer are present as impurities rather than major photolysis products. Large variations in the product yields and the detection of ethylene from one batch and acetylene from another emphasize the importance of small impurities and imperfections in the photolysis of a highly stable polymer such as polystyrene Changes in the ultraviolet spectra during photolysis are compatible with the formation of conjugated double bonds along the main chain; in air, these changes are supplemented by oxidation which results in carbonyl formation along the chain and a relatively small fragment absorbing at about 340 mμ. Author

N65-30687# United States Rubber Co., Wayne, N. J. Research Center.
PROTECTIVE COATINGS FOR DEEP SUBMERGENCE VESSELS Quarterly Report, 18 May–18 Aug. 1964
D. C. Mac Donald and A. S. Glowacki 28 Aug. 1964 18 p
(Contract NObs-90246)
(QR-2; AD-604573)

Stress cycling of resin/fiberglass laminates at fiber stresses ranging from 13 000 to 70 000 psi does not significantly alter the physical properties of the laminate. At high fiber stress levels, laminates developed cracks parallel to the surface filaments. These cracks were observed after 10 000 cycles at fiber stresses in excess of 50 000 psi. Author

N65-30688# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
ULTRACENTRIFUGATION AT VARIABLE ANGULAR VELOCITY—DERIVATION OF BASE EQUATIONS
Matatiahu Gehatia Apr. 1965 22 p refs
(AFML-TR-64-377; AD-615966)

Experiments were conducted to determine whether ultracentrifugation techniques could be used in evaluating elastic intramolecular forces and the elastic properties of high polymers in solid state. Sedimentation equations were derived based on assumptions concerning the shape of macromolecules in solution dependent upon the centrifugal field which can be varied. Angular velocity, sedimentation coefficient, and diffusion coefficient were considered as general functions of time. Considering the displacement of the flowing particles as being very small in comparison with their average radial distance from the center of rotation, the dependency upon the centrifugal field is seen as dependent on the angular velocity alone. The formula for the concentration appearing in a sectorial synthetic boundary cell is given, and an approximate equation for the gradient of concentration is expressed. It was concluded that additional information can be obtained on the shape of sedimenting particles and the intramolecular field, if the relationships between the concentration and the parameters of shape are derived from the theory of hydrodynamics. M.G.J.

N65-30690# Naval Research Lab., Washington, D. C.
SOME SURFACE CHEMICAL ASPECTS OF GLASS-RESIN COMPOSITES. PART 2: THE ORIGIN AND REMOVAL OF MICROVOIDS IN FILAMENT-WOUND COMPOSITES Interim Report
W. D. Bascom 24 May 1965 9 p refs
(NRL-6268; AD-616920)

Previous work of this program established that a very considerable number of air microvoids are entrained in the glass roving during the winding of glass-resin composites. Air entrapment results from the difficult capillary penetration of resin into spaces between filaments during the impregnation process. The poor resin wettability of commercially finished filaments aggravates the situation. Microscopic examination has shown that the microvoids observed in glass-filament rovings are also present in cured, filament-wound composites, prepreg roving, and glass-resin laminates. The voids are present to the extent of 10^7 to 10^9/cu in., are about 0.4 mil in diameter, and have lengths from 0.4 to 20 mils and even greater. A microscopic examination was made of the process of resin impregnation into a strand of glass filaments under simulated winding conditions with particular attention given to the effect of the operating variables on air entrapment. When the contact angle of the resin against the individual filaments was nonzero the void content was too high to be measurable, even at low resin viscosities and slow strand speeds. On the other hand, reducing the contact angle to zero or causing the tension to oscillate as the strand passed through the resin markedly reduced the number of voids. A combination of good wetting and oscillating strand tension gave better results than either alone. These observations can be explained in terms of the forces that obstruct the release of the air bubbles from between filaments. Author

N65-30777# Kaysam Corp. of America, Patterson, N. J.
NEOPRENE ELASTOMERS FOR BALLOON FABRICATION Final Report, 1 Mar. 1964–28 Feb. 1965
Eric Nelson 15 Apr. 1965 136 p ref
(Contract DA-36-039-AMC-03737(E))
(AD-616757)

Dry neoprene polymers can be evaluated for meteorological balloon purposes by using a solution dipping technique. This provides a method of determining suitability of polymers for balloons without first producing them in latex form. Evaluation of neoprene latex LD-569 revealed physical properties, but difficulty was encountered in producing balloons from it. Study of antioxidants resulted in development of a compound

with superior resistance to heat and oxygen aging. Several filter media for latex compounds were evaluated. Photomicrographic examination of compounding ingredients and balloon films did show how easily the balloon film can suffer surface damage by abrasion. Better flight performance can be expected if balloons are cured at lower temperatures than those that produce optimum laboratory physical characteristics. Excellent flight performance was obtained with balloons made from a high elongation compound. Author

N65-31059*# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF MATERIAL SPECIFICATIONS AND QUALIFICATIONS OF POLYMERIC MATERIALS FOR THE JPL SPACECRAFT MATERIALS GUIDE BOOK. III: POLYFLUOROCARBON FILMS Special Report No. 3
Judith A. Black, Jorge Heller, and Dean B. Parkinson 12 Jul. 1965 18 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950745; SRI Proj. PRD-5046-1) (NASA-CR-64350) CFSTI: HC $1.00/MF $0.50 CSCL 11I

Preliminary outgassing studies were performed on selected polyfluorocarbon films. Five types of film, four of the Tedlar polyvinyl fluoride films, and one Teflon FEP, were heated to 150° C and 5 X 10^{-6} mm Hg for over 200 hours. Weight losses for all materials tested were very low, ranging from zero to about 0.5%. Duplicate test specimens of Teflon FEP, differing only in size, were also tested in order to estimate the effect of sample size on weight losses, but no clear relationship was found. No condensable oils were evolved from the test specimens. All Tedlar samples underwent very slight darkening during thermal vacuum treatment, and an ultraviolet-visible spectrum was run on one of the specimens; the Teflon FEP samples were unchanged. In view of their low weight losses and the absence of condensable volatiles, all these materials seem suitable for spacecraft applications. Author

N65-31230# Advisory Group for Aeronautical Research and Development, Paris (France).
COMPOSITE MATERIALS [MATERIAUX COMPOSITES]
G. Dixmier and George Gerard Jul. 1965 55 p In FRENCH and ENGLISH
(AGARD-483)

Composite materials are becoming increasingly important in various areas of aerospace design. Specific aspects of composite materials have been brought to the fore by the successful use of reinforced plastics as high strength materials. This achievement has called attention to the mechanism of the reinforcement of a low modulus matrix by high modulus, high specific strength fibrous materials. The hope has arisen of adapting this achievement to other structural requirements by reinforcing metal matrices with high rigidity, high tensile strength reinforcements such as whiskers and metallic filaments for various temperature applications. The studies of the AGARD Materials Committee have made it possible to prepare a list of research problems which are considered to be most important for the promotion of the rapid development of composite materials for aerospace applications. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-30227 Joint Publications Research Service, Washington, D. C.
DYNAMIC MAPPINGS AND ONE CLASS OF DETERMINISTIC MACHINES
D. A. Suprunenko and R. I. Tyshkevich *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 16-33 refs (See N65-30225 19-10) CFSTI: $6.00

The functioning of deterministic systems is studied through computation of dynamic mappings and certain of its generalizations, and also by functional analyses of the machines developed from these computations. Considered are machines with a constant mode, computers without internal evolutions, and also triangular machines containing the axiom of constant modes as well as a set of all its modes. G.G.

N65-30231 Joint Publications Research Service, Washington, D. C.
SOME COMPLETE SYSTEMS OF OPERATIONS AND CANONICAL FORMS FOR REPRESENTATION OF MULTIVALUED LOGIC FUNCTIONS
N. N. Ayzenberg and A. L. Rabinovich *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 69-85 refs (See N65-30225 19-10) CFSTI: $6.00

Complete systems of operations were examined in m-valued logic under conditions where each system enters into conjunction or negation. The described systems can be used to construct functions analogous to normal forms of algebraic expressions for synthesizing logic networks of elements from a multivalued structural alphabet. G.G.

N65-30234 Joint Publications Research Service, Washington, D. C.
PARALLEL INTERPOLATING INTEGRATING DIGITAL COMPUTERS WITH MULTIDIGIT INCREMENTS
O. N. P'yavchenko *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 115-132 refs (See N65-30225 19-10) CFSTI: $6.00

The use of digital integrating computers with high operational speed and a calculation accuracy to four six-hundredths places is discussed for: (1) differential methods for solving common differential equation systems; and (2) iterative methods for solving common differential equation systems by interpolational differential equations. G.G.

N65-30238 Joint Publications Research Service, Washington, D. C.
SEQUENTIAL ALGORITHMS OF OPTIMIZATION AND THEIR APPLICATIONS, II
V. C. Mikhalevich *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 159-167 ref (See N65-30225 19-10) CFSTI: $6.00

Algorithms of sequential solution search are presented that are applicable to situations describing a set of individual objects $\Omega = \{\omega\}$, where each ω has a probability of 0 or 1. Risk functions and a solution of recurrent equations for risk are examined, and examples of inaccuracy search in a sequential series, as well as a definition of the optimal mode of a controlling apparatus are given. G.G.

N65-30239 Joint Publications Research Service, Washington, D. C.
ON DECOMPOSITION OF AN UNCONNECTED GRAPH INTO A CARTESIAN PRODUCT
K. A. Zaretskiy *In its* Cybernetics, No. 2, 1965 20 Jul. 1965 p 168-169 ref (See N65-30225 19-10) CFSTI: $6.00

The non-single-valued decomposition of unconnected graphs into Cartesian products of simple graphs was established by writing each graph in the form of a polynomial with whole, non-negative coefficients, and by reducing the equality to a

common multiple. It was concluded that non-single-valued expansion graphs must have not less than 6 components, because a graph with a simple number of components, or with 4 components, is expanded always single-valuedly into a Cartesian product of simple graphs. G.G.

N65-30244# Aerospace Corp., El Segundo, Calif.
A SECOND-ORDER PARAMETER OPTIMIZATION PROCEDURE
B. L. Beskind 31 May 1965 20 p refs
(Contract AF 04(695)-469)
(SSD-TR-65-57; TDR-469(5560-20)-1; AD-617371)

In the past, the optimization of complex systems has been accomplished by iterative steps in a gradient direction determined from a linearized model of the system. When the system can be described in terms of time-invariant parameters, it is relatively straightforward to approximate the system's behavior with second-order expansions rather than first-order, and to then optimize the system on the basis of its approximated behavior. Two different mathematical methods for accomplishing this optimization are described. Numerical examples indicate that a second-order optimization method may be significantly faster and more versatile than the linear gradient method, and that further investigation is warranted. Author

N65-30262 Joint Publications Research Service, Washington, D. C.
FULLY ADDITIVE VECTOR FUNCTIONS, III (A PROBLEM OF YU. CH. NEYMAN)
A. A. Lyapunov *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 260–265 refs (See N65-30250 19-10) CFSTI: $7.00

The study of fully additive vector functions is considered essential for investigation of problems, such as making decisions on fair sharing, related to cybernetics; and a solution is presented for a system of continuous distribution laws. Behavior of the vector functions is analyzed, and the situation is considered with and without a designated constraint. M.W.R.

N65-30263 Joint Publications Research Service, Washington, D. C.
FULLY ADDITIVE VECTOR FUNCTIONS, IV
A. A. Lyapunov *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 266–282 refs (See N65-30250 19-10) CFSTI: $7.00

The values of a vector function dependent upon a system of sets was investigated. In some instances the system of sets was subordinated to certain constraints of the theory-of-sets nature. Disjoint sets covering the entire space were considered. It is suggested that the convexity and closed nature of the value set of certain vector functions take place under very general conditions, and appropriate proofs are offered. The power of preimages is also considered relative to the optimal utilization of an area given certain alternatives; this is related to decision-making. M.W.R.

N65-30267 Joint Publications Research Service, Washington, D. C.
ON THE "SUPERPOSITION" OF ABRIDGED DISJUNCTIVE NORMAL FORMS
Yu. I. Vasil'yev *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 365–369 ref (See N65-30250 9-10) CFSTI: $7.00

A theorem relating to the superposition of disjunctive normal forms is stated. Definitions are given and a proof is presented. M.W.R.

N65-30269 Joint Publications Research Service, Washington, D. C.
CERTAIN PROPERTIES OF ESSENTIAL FUNCTIONS BELONGING IN Pk
Ye. Yu. Zakharova and S. V. Yablonskiy *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 374–382 ref (See N65-30250 19-10) CFSTI: $7.00

Functions which belong to k-valued logic are considered essential if the depend on more than one argument and if all the k values are assumed. Definitions dealing with the essential function, characteristic set, and matrix property are introduced. Statements relating to characteristic matrices are proven. The structure of an arbitrary characteristic cul-de-sac set of an essential function is investigated, and a theorem related to the structure of the matrix is given. Other theorems deal with the number of rows a matrix may have and the maximum number of arguments for a simple essential function. M.W.R.

N65-30270 Joint Publications Research Service, Washington, D. C.
INVARIANT OPERATIONS WITH EVENTS
Yu. I. Yanov *In its* Probl. of Cybernetics, No. 12, 1964 22 Jul. 1965 p 383–390 refs (See N65-30250 19-10) CFSTI: $7.00

A class of invariant functions conserving the regularity of events for sets of words is termed strong if it generates all the non-empty regular events from elementary events. Definitions are given relating to the basic functions of arbitrary alphabets, the elements or objects of the set and the scatter of any objects. It is ascertained that the basic function is invariant and that any invariant function depends essentially on all of its arguments. For any strong set specified algebras lack a finite complete system of identities. Any strong system of functions from a set which is closed with respect to superpositions contains at least three functions. M.W.R.

N65-30271# Dunlap and Associates, Inc., Darien, Conn.
TWO EXTENSIONS OF STATISTICAL DECISION THEORY Final Report
U. O. Gagliardi Bedford, Mass., AFSC, Electron. Systems Div. Jan. 1965 36 p refs
(Contract AF 19(628)-4303)
(ESD-TDR-65-216; AD-617082)

The objective of the project was to develop broader formulations of the mathematical (statistical) theory of decision. This report presents two broad scope generalizations which have resulted from the project. The first generalization discussed is a decision-making model which applies to the case of a not well-informed decision maker with independent data sources. In this model, the inference about the prior distribution is determined from the solution of an adjunct decision problem which specifies the minimum risk hypothesis in the light of the available information. The second generalization presented is a model of multi-period decision making for both stationary and Markovian environments. In contrast to the model discussed in the above paragraph, this model does not assume independent data sources, i.e., that the observation processes are not affected by the actions of the decision maker. Author

N65-30441# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF COMPUTER MATHEMATICS AND MATHEMATICAL PHYSICS
15 Mar. 1965 27 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 2, 1964 p 303–316, 376–379
(FTD-MT-64-458; AD-614630)

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1. ANALYSIS OF FLOW AROUND BLUNT BODIES WITH DETACHED SHOCK WAVE BY AN EQUILIBRIUM DISSOCIATING GAS O. M. Belotserkovskiy, M. M. Golomazov, and N.P. Shulishnina p 1–16 refs (See N65-30442 19-12)

2. ON A METHOD OF SELECTION OF INPUT VARIABLE IN SIMPLEX METHOD OF LINEAR PROGRAMMING V. A. Mash p 17–23 refs (See N65-30443 19-19)

N65-30443 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON A METHOD OF SELECTION OF INPUT VARIABLE IN SIMPLEX METHOD OF LINEAR PROGRAMMING

V. A. Mash *In its* J. of Computer Math. and Mathematical Phys. 15 Mar. 1965 p 17–23 refs (See N65-30441 19-19)

A modification is proposed to the traditional simplex linear programming method of input variable selection based on the fastest possible elimination of artificial variables. This modified method uses successive improvement based on the cheapest reduction of sum of values of variables per unit occurring on every iteration with least increase of part of the functional not depending on M, where M is cost associated with the artificial variables. The plan is thereby conditionally-optimum and finally attained even before the reduction to zero of all artificial variable values. W.M.R.

N65-30447# Massachusetts Inst. of Tech., Cambridge.

DEMAND MODELS FOR INVENTORY SYSTEMS Technical Note No. 4

George R. Murray, Jr. and Kenneth R. Scott Mar. 1965 37 p refs

(Contract DA-31-124-ARO-D-209)

(AROD-968-39; AD-466140)

The usual situation in the formulation of a practical inventory problem is that the analyst must infer a suitable mathematical description of the demand process from a sample of demand data. The work reported in this paper was carried out to provide the analyst with some models that are helpful in drawing this necessary inference. In the authors' experience, these tools are particularly useful when only limited historical demand data is available. The basic model of the demand process examined in this paper consists of a central location from which a group of N customers obtain their supply of an item (or, in one case, a product line). The customers maintain some stocks on hand, and order from the central location in a more or less periodic fashion. The only requirement placed on the ordering habits of the customers is that they are unlikely to order twice during one interval of length t_0, and that each customer has established for himself an order size that he continues to use without change. Author

N65-30509# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.

A DYNAMIC PROGRAMMING FORMULATION FOR DISPOSABLE AND REPARABLE INVENTORY

Ernest Gerald Hurst, Jr. (M.S. Thesis) Jun. 1965 253 p refs

(Contracts DA-31-124-ORD-14; DA-31-124-ARO(D)-209)

(TR-12; AROD-968-40; AD-466769)

A simple model of inventory in which only procurement is possible and at a proportional cost is thoroughly reviewed to introduce the notation and motivate the later extensions. The option of disposal in introduced and an optimal structure similar to that in the previous case is obtained for proportional action costs. Repair is introduced at first without disposal. The components of a quite general loss structure are discussed, and for this loss function and proportional action costs the optimal structure is obtained. Analogous general results with set-up costs added are again shown to be impossible, but the single stage structure for two different set-up cost configurations is obtained. All possible action options are included and the structure derived for restricted costs is shown to hold for the very general loss functions and proportional action costs. A single stage structure with action set-up cost is obtained. The theoretical results are compared to the actual operating procedures which first motivated the study and suggestions are made for further applied as well as theoretical research. Author

N65-30555# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.

EXISTENCE, UNIQUENESS, AND STABILITY FOR NONLINEAR DIFFERENTIAL-DIFFERENCE EQUATIONS IN THE NEUTRAL CASE

Wolfe Snow Feb. 1965 56 p refs

(Contract Nonr-285(55))

(IMM-NYU-328; NR-062-160; AD-613066)

For ordinary differential equations it is well known that an equilibrium solution is stable if the linearized equation has only exponentially decaying solutions. The differential-difference equation $u'(t+s) - u'(t) + au(t+s) = g(t, u(t), u(t+s))$, $a > 0$, $s > 0$, when linearized, also has decaying exponentials $\exp(st)$, but the characteristic roots s approach the imaginary axis. The problem arises—do solutions of this equation decay. An affirmative answer is obtained for this problem, the rate of decay depending upon the smoothness of the initial data and nonlinear term and the rate of approach of the characteristic roots to the imaginary axis. Then this result is applied to a transmission line problem. Also, an example is given of a homogeneous linear ordinary differential-difference equation with constant coefficients, whose characteristic roots all lie in the left half plane, having an unbounded solution. Author

N65-30576# Texas A&M Univ., College Station.

SOLUTIONS OF DIFFERENTIAL EQUATIONS BY LINEAR PROGRAMMING TECHNIQUES

Jake Lee Saye, Jr. (M.S. Thesis) May 1965 67 p refs

(Contract AF 33(608)-1120)

(AD-616715)

A numerical method for solving linear differential equations is developed by means of linear programming, and the validity of this method is investigated. Particular attention was given to two point boundary value and initial value problems. The theory, the duality problem, and the simplex method are reviewed. Linear differential equations and limited solutions to them are discussed; the linear programming method is outlined; and the derivation of the linear system is shown. The stability, accuracy, convenience, and versatility of the method is pointed out, and examples using ordinary linear differential equations of the second order are included. C.T.C.

N65-30577# Wisconsin Univ., Madison. Mathematics Research Center.

OBSERVABLES AND DERIVATIVES. PART I: SPECIAL TYPES Technical Summary Report

Stanley P. Gudder May 1965 21 p refs

(Contract DA-11-022-ORD-2059)

(MRC-560; AD-616868)

This paper is concerned with special types of observables and derivables and the relationships between them. In particular, we consider special types of derivables classified according to their spectra and then characterize these derivables in ways which are independent of their spectra. After an introduction and review of definitions and notation, Section 3 considers derivables with countable spectra; Section 4 treats a class of derivables which are particularly easy to handle

called compact derivables; in Section 5 we consider bounded derivables; and in Section 6, derivables with positive spectra and spectra with unit modulus. In Part II of this paper, we shall discuss uniqueness and existence properties of bounded observables. Author

N65-30580# California Univ., Berkeley. Operations Research Center.
NONPARAMETRIC LIFE TEST SAMPLING PLANS
Richard E. Barlow and Shanti S. Gupta (Purdue Univ.) 30 Jul. 1964 74 p refs
(Contracts Nonr-3656(18); Nonr-225(53); AF 33(657)-11737) (ORC-64-14(RR); AD-613273)

Nonparametric sampling plans for truncated life tests based on percentiles under the increasing (decreasing) failure rate assumption and on mean life are presented. Sampling plans for the mean increasing failure rate distribution, and quantiles of increasing and decreasing failure rate distributions are tabulated. R.N.A.

N65-30584# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A NOTE ON GENERATING CHI RANDOM NUMBERS
M. D. Mac Laren Sep. 1962 6 p ref
(DI-82-0201)

A method for generating numbers with chi distribution is presented. The method is similar to a previously described method for generating exponential random numbers on a digital computer. The random numbers with chi distribution may be used to generate normal random numbers. N.E.A.

N65-30657# Rutgers Univ., New Brunswick, N. J. Statistics Center.
CHAIN SAMPLING INSPECTION PLANS: ChSP-0,2 AND ChSP-1,2
K. S. Stephens and H. F. Dodge May 1965 44 p refs
(Contract Nonr-404(18))
(TR-N-21; AD-616751)

In this report, major emphasis is devoted to the theoretical development and the evaluation of two-stage chain sampling plans designated ChSP-0, 2 and ChSP-1,2, i.e., those plans having acceptance numbers of C_1, C_2 = 0,2 and 1,2 applicable to cumulative results. The scope, general plan, and operating procedures of these plans are the same that are given in detail in report N-20. Two methods of evaluation are considered—enumeration of acceptable sequences of defectives, and the use of Markov Chains. The latter is preferred due to its facility in handling the plans to be considered. It is also capable of being generalized to evaluate the complete family of chain sampling plans. For this reason, a brief discussion is presented of the stochastic process involved, and the solution of the Markov Chains associated with ChSP procedures. In the discussion of the operating characteristics of these plans, some comparisons are made between chain sampling plans and double sampling plans. N.E.A.

N65-30669# RAND Corp., Santa Monica, Calif.
DYNAMIC PROGRAMMING, SYSTEM IDENTIFICATION, AND SUBOPTIMIZATION
Richard Bellman Jun. 1965 17 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4593-PR; AD-616780)

The mathematical technique of dynamic programming is used to obtain a best-fit approximation to a function that is defined over some given interval. It is then shown how this technique may be used as an approach to the handling of a certain type of pattern recognition problem and to the approximation of optimal control policies. E.W.

N65-30703# RAND Corp., Santa Monica, Calif.
LIMIT THEOREMS INVOLVING CAPACITIES
Sidney C. Port Jun. 1965 57 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4561-PR; AD-617188)

We investigate the asymptotic behavior of $P_x(T_B > n)$, $P_x(n < V_B < \infty)$ and several related quantities in a denumerable state space transient Markov chain. Here T_B, V_B are respectively the time of last and first visit to the finite nonempty set B. Applications are given to several specific Markov chains. Author

N65-30706# Texas Technological Coll., Lubbock.
THE EFFECT OF THE NORMALITY AND HOMOGENEITY OF VARIANCE ASSUMPTIONS UPON THE VALIDITY OF THE F TABLE FOR INTERACTION TERMS
Curtis O. Zeigler (M.S. Thesis) May 1965 77 p refs
(Contract AF 33(608)-1119)
(AD-616722)

The purpose of this thesis is to investigate the validity of the F Table under the following conditions: first, when the assumption of common variance is violated and, secondly, when both the normality and homogeneity of variance assumptions are violated. Using a factorial design, with special interest in the effects upon interactions, this investigation is concerned with the validity of the F Table by simulating experiments with the data source being from different distributions, each containing an uncommon variance. TAB

N65-30729*# National Aeronautics and Space Administration, Washington, D. C.
CERTAIN PROBLEMS IN THE THEORY OF STABILITY OF MOTION IN THE WHOLE
V. A. Pliss Aug. 1965 197 p refs Transl. into ENGLISH of the book "Nekotoryye Problemy Teorii Ustoychivosti Dvizheniya v Tselom" Leningrad, Izd. Leningr. Univ., 1958
(NASA-TT-F-280) CFSTI: HC $5.00/MF $1.25 CSCL 12A

In this monograph, certain nonlinear systems of three differential equations are considered. It is assumed that the nonlinearities entering into the system satisfy the generalized Hurwitz conditions. Sufficient conditions for stability in the whole and conditions for which the systems considered have periodic solutions are also considered. Conditions are imposed on the parameters of the systems which are necessary and sufficient for stability in the whole for any nonlinearity. This work can be useful to specialists in the qualitative theory of differential equations and the theory of automatic control. Author

N65-30751# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A UNIFIED APPROACH TO THE SYNTHESIS OF ORTHONORMAL EXPONENTIAL FUNCTIONS
J. M. Mendel Jun. 1964 57 p refs
(SM-47667; AD-613547)

In this report a unified approach is presented for the construction of sets of orthonormal exponential functions, whose elements have the properties, that: (1) they are orthonormal with respect to the weighting function e^{-2bt}, $b \geq 0$; (2) their asymptotic order may be chosen arbitrarily, and; (3) their poles may be real, complex, or some may be real and others may be complex. The main results are summarized as theorems and propositions in which the sets of exponentials are derived as transfer functions in the s domain. These theorems and propositions, in effect, supplement the more conventional Gran-Schmidt Procedure which is useful for the orthonormalization of functions in the time domain. Examples are given

which illustrate applications of the main results. In addition, a generalized spectrum analyzer, which can be synthesized on an analog computer, is developed for use in the automatic evaluation of Fourier coefficients. Author

N65-30769# Wisconsin Univ., Madison. Mathematics Research Center.
MULTISTEP METHODS FOR THE NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS MADE SELF-STARTING
Diran Sarafyan May 1965 17 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-495; AD-616870)

Milne's method and other similar multistep ones for the approximate solution of differential equations, are not self-starting. They require the use of known p pivotal points $(X_i, y(x_i))$, $i = 0.1, \ldots, (p-1)$, where x's are equally spaced and $y = y(x)$ is the solution of the differential equation. Usually these pivotal points are generated through the use of a set of so-called p-point formulas, preferably p being an odd integer. But these p-point formulas are not self-starting either. A rotational method is established herein which will make these p-point formulas, and consequently also the multistep methods, self-starting. Subsequently the method is extended to systems of differential equations. Author

N65-30773# RAND Corp., Santa Monica, Calif.
SOME TABLES OF THE NEGATIVE BINOMIAL DISTRIBUTION AND THEIR USE
Bernice Brown Jun. 1965 38 p refs
(Contract AF 49(638)-700)
(RM-4577-PR; AD-616727)

Tables giving the values of the individual terms of the negative binomial distribution for 130 pairs of parameter values are presented. The cumulated terms of the same distributions are in a form directly usable for solving problems which require the determination of probabilities of the occurrence of not more than x events. The negative binomial distribution is described and illustrative examples are given which use this distribution as a tool in the study of demand for replacement parts. The references indicate that the negative binomial has been used in a wide variety of applications to biological research. Author

N65-30780# Wisconsin Univ., Madison. Mathematics Research Center.
CLASSIFICATION AND REDUCTION OF SECOND ORDER SYSTEMS AT A TURNING POINT
R. J. Hanson and D. L. Russel Mar. 1965 41 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-557; AD-616875)

This report deals with second order systems of linear ordinary differential equations

$$\epsilon^h \frac{d\vec{y}}{dx} = A(x,\epsilon)\vec{y},$$

where $A(x,\epsilon)$ is analytic for

$$|x| < \delta_0,\ 0 < |\epsilon| < \epsilon_0,\ |\arg \epsilon| < \alpha_0.$$

It is shown that every turning point problem arising from such systems is equivalent to a system

$$\epsilon^h \frac{d\vec{y}}{dx} = \left[\begin{pmatrix} 0 & x^k \\ x^{k+p} & 0 \end{pmatrix} + O(\epsilon)\right]\vec{y},$$

which is referred to as a turning point problem of type T(h,k,p). It is shown that turning point problems of types T(h,0,p) or T(1,k,p) can be analytically reduced to systems wherein the matrix on the right hand side of the equation is a polynomial in x with coefficients which are analytic functions of ϵ. Author

N65-30789# Wisconsin Univ., Madison. Mathematics Research Center.
THE INITIAL-BOUNDARY VALUE PROBLEM FOR A NONLINEAR HYPERBOLIC EQUATION IN RELATIVISTIC QUANTUM MECHANICS
Jerome Sather Mar. 1965 41 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-550; AD-616869)

Considerable attention has been focused on the equation

$$u_{tt} - \Delta u + u|u|^{\gamma} = f\ (\gamma > 0)$$

in the last four years. This paper is concerned with the corresponding initial-boundary value problem. Existence theorems for weak and strict solutions and continuity of weak solutions with respect to the data of the problem are established. Author

N65-30790# Wisconsin Univ., Madison. Mathematics Research Center.
ON COMPLEMENTARY VARIATIONAL PRINCIPLES
L. B. Rall May 1965 20 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-558; AD-616867)

Variational problems which are formulated in terms of finding maxima or minima of functionals usually lead to only one-sided bounds for approximate solutions. It has been shown recently by B. Noble that a number of variational problems may be formulated in terms of complementary variational problems, the approximate solutions of which give both upper and lower bounds for the desired stationary value. In this paper, complementary variational principles are formulated abstractly in Hilbert space. Necessary and sufficient conditions are given for a system of two equations to represent a variational principle, and sufficient conditions are given for the variational principle to be complementary. Author

N65-30791# Wisconsin Univ., Madison. Mathematics Research Center.
PERTURBATION OF ORDINARY DIFFERENTIAL OPERATORS
Robert E. L. Turner Apr. 1965 18 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-561; AD-616873)

A perturbation theorem is proved which enables us to extend the results of J. Schwartz and others, to the effect that a wide class of boundary value problems for ordinary differential operators with operator valued coefficients generate unbounded operators in the L_2 space over a finite interval. Thus under mild restrictions on the boundary conditions allowed, an operator

$$\left(\frac{1}{i}\frac{d}{dx}\right)^n + C_{n-1}\left(\frac{d}{dy}\right)^{n-1} + B_{n-2}\left(\frac{d}{dx}\right)^{n-2} + \ldots + B_0$$

in $L_2[0,1]$, where $B_0, \ldots, B_{n-2}$ are arbitrary bounded operators and C_{n-1} is any compact operator plus a bounded one with small norm, is shown to have a complete set of generalized eigenfunctions $|\phi_n|$. Moreover, the series expansions in the ϕ_n are unconditionally convergent. Author

N65-30792# Wisconsin Univ., Madison. Mathematics Research Center.
ON POLYA FREQUENCY FUNCTIONS IV: THE FUNDAMENTAL SPLINE FUNCTIONS AND THEIR LIMITS Technical Summary Report

H. B. Curry and I. J. Schoenberg [1965] 48 p refs
(Contract CA-11-022-ORD-2059)
(MRC-TSR-567; AD-616871)

The theory of spline functions is developed to a point which allows us to establish the properties of spline interpolation for the case of multiple nodes. The genesis of Polya frequency functions from spline functions is developed. Author

N65-30812# Wisconsin Univ., Madison. Mathematics Research Center.
MULTIPLE INTEGRALS INVOLVING PRODUCT OF MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND
F. M. Ragab Feb. 1965 20 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-541; AD-615745)

The following two multiple integrals are evaluated

$$\prod_{r=1}^{m-1} \int_0^\infty \lambda_r^{k_r-1} K_{\nu_r}(\lambda_r) d\lambda_r K_\mu[x(\lambda_1 \ldots \lambda_{m-1})^{\pm 1}].$$

Also the asymptotic behavior of the two integrals as $|x| \to 0$ and as $|x| \to \infty$ is given. Author

N65-30814# Wisconsin Univ., Madison. Mathematics Research Center.
AN ARSENAL OF ALGOL PROCEDURES FOR THE EVALUATION OF CONTINUED FRACTIONS AND FOR EFFECTING THE EPSILON ALGORITHM
P. Wynn Jan. 1965 59 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-537; AD-615744)

An integrated system of Algol procedures for the evaluation of continued fractions with real coefficients and for the transformation of slowly convergent sequences by means of the ϵ-algorithm is given. Use of the procedures is illustrated by the computation of a number of classical functions of Mathematical Physics. Author

N65-30815# Wisconsin Univ., Madison. Mathematics Research Center.
AMBIGUOUS POINTS OF ARBITRARY PLANAR SETS AND FUNCTIONS
Frederick Bagemihl Feb. 1965 26 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-543; AD-615746)

Let S be a subset of the plane P, and $T = P - S$. If there exist two arcs terminating in a point $\zeta \in P$ such that one belongs wholly to S and the other wholly to T, then we say that ζ is an ambiguous point relative to S. In the first part of the paper the structure of the set of ambiguous points is investigated under various restrictions on the arcs of ambiguity. For example, for any S, not every point of P is an ambiguous point if the arcs of ambiguity are required to be rectilinear segments with opposite directions. However there does exist an S such that every point of P is an ambiguous point with rectifiable arcs of ambiguity. The second part of the paper deals with curvilinear cluster sets of complex-valued functions defined in the plane. It is proved, for example, that there exists a bounded function for which every point of P is an ambiguous point with rectilinear arcs of ambiguity and some element of an enumerable set of angles as direction of ambiguity. The continuum hypothesis is shown to imply the existence of functions with even more striking ambiguous behavior. Author

N65-30827# Michigan Univ., Ann Arbor. Dept. of Communication Sciences.
DECISION PROBLEMS FOR MULTIPLE SUCCESSOR ARITHMETICS
J. W. Thatcher (IBM, Yorktown Heights, N. Y.) Apr. 1965 28 p refs *Its* Rept.-03105-36-T
(Contract Nonr-1224(21); Grants NSF GP-2539; DA-ARO(D)-31-124-G588)
(AROD-4049-12; AD-615085)

Let N_k denote the set of words over the alphabet $\Sigma_k = \{1, \ldots, k\}$. N_k contains the null word which is denoted λ. We consider decision problems for various first-order interpreted predicate languages in which the variables range over $N_k (k \geq 2)$. Our main result is that there is no decision procedure for truth in the interpreted language which has the subword relation as its only non-logical primitive. This, together with known results summarized in the report, settles the decision problem for any language constructed on the basis of a large number of relations and functions. Author

N65-30856# Wisconsin Univ., Madison. Mathematics Research Center.
REPRESENTATIONS FOR THE GENFRALIZED INVERSE OF SUMS OF MATRICES II Technical Summary Report
Randall E. Cline Mar. 1965 13 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-559; AD-616866)

A representation is obtained for the generalized inverse of any matrix sum U + V. Various special cases are considered. Author

N65-30916# Stanford Univ., Calif. Computer Science Dept.
FINITE DIFFERENCE METHODS FOR THE EIGENVALUES OF LAPLACE'S OPERATOR
Cleve B. Moler 27 May 1965 146 p refs
(Contract Nonr-225(37))
(CS22; AD-616675)

Methods for approximating eigenvalues and corresponding eigenfunctions for a fixed membrane and certain geometrically simple regions were studied. Emphasized is the method of finite differences. Investigated were four finite difference operators which approximate the Laplacian operator. Presented are derivations for each operator, a discussion of several of their algebraic properties, and comparative data which give an indication of the type of general results which may be expected. Considered are domains with no reentrant corners, but for which interpolation may be required. Also analyzed are two methods for computing the solution of the difference problem. S.C.W.

N65-30972# RAND Corp., Santa Monica, Calif.
ON A CLASS OF NONLINEAR DIFFERENTIAL EQUATIONS WITH NONUNIQUE SOLUTIONS
Richard Bellman Jun. 1965 4 p Submitted for Publication
(P-3147; AD-617001)

A class of nonlinear differential equations is described subject to conditions analogous but not equivalent to multipoint conditions which can possess an infinite number of solutions. These equations are suggested by some work in respiratory control theory which will be described elsewhere. TAB

N65-31023# Boeing Scientific Research Labs., Seattle, Wash.
TWO-POINT BOUNDARY VALUE PROBLEMS OF FOURTH ORDER WITH POSITIVE GREEN'S FUNCTIONS
Johann Schröder Feb. 1965 27 p ref *Its* Math. Note No. 393
(DI-82-0412)

There are derived sufficient conditions for the positivity of Green's function of two-point boundary value problems of the fourth order. The results are gained by applying a theorem on inverse-monotonic operators in partially ordered spaces. In the case of an example (beam on elastic support), the derived conditions are also necessary. Author

N65-31044 Joint Publications Research Service, Washington, D. C.
EXPANSION AND APPLICATION OF A REGULAR EXPRESSION TO A BASE
M. A. Spivak *In its* Noise Immunity Codes and Regular Expressions in Cybernetics 10 Aug. 1965 p 7–10 refs (See N65-31042 19-07) CFSTI: $1.00

The language of regular expressions is one of the most widespread languages for notation of conditions of operation of an automaton. In this paper a simple algorithm is given which permits abstract synthesis for the expanded language of regular expressions. It is based on an expansion of the regular expressions with respect to some system of regular expressions called a base. Use of the expansion with respect to a base in conversion and simplification of regular expressions is included. E.W.

N65-31140*# Iowa State Univ., Ames.
TABLES OF ELLIPTIC INTEGRALS
William Joel Nellis Washington, NASA, Aug. 1965 48 p refs (Grant NsG-293)
(NASA-CR-289) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The tables present a method of evaluating elliptic integrals of the first and second kinds by means of the R function, a hypergeometric function of several variables. The general method is to reduce an integral of elliptic type to an R function by means of integral formulas. The formulas are then used to reduce the E functions to a linear combination of two standard R functions and an algebraic function. The two standard functions, R_K and R_E (in the complete case) or R_F and R_G (in the incomplete case), are normal elliptic integrals of the first and second kinds. Numerical values of the normal integrals over a limited range are given. The values are intended only to give an idea of the behavior of the functions and should not be used for interpolation near $x = 0$ or $y = 0$. Author

N65-31147# RAND Corp., Santa Monica, Calif.
THE APPLICATION OF STOCHASTIC PROCESSES TO COUNTDOWN ANALYSIS
David S. Stoller May 1965 21 p refs Presented at the NATO Conf. on Operations Res., Lisbon, 27 Sep.–1 Oct. 1965
(P-3148; AD-616997)

Countdown plans for launch vehicles, ground systems, and range systems were mathematically modeled in terms of a time-referenced finite sequence of states, to aid in the decision process of whether to continue or reschedule the countdown. Each element in the sequence is described by a vector consisting of an operational state component, and an action component. The policy and decision rules, objectives, measures, and criteria for the countdown plans are discussed. A chart showing the acceptance risk for continuing or rescheduling countdown, based on the probability thay the mission is completed is given. Alternative plans were run on the computer to illustrate the use of the model for countdown planning and evaluation over a wide variety of policies, and the results are shown graphically in terms of percent probability of a delay of less than a given number of hours. The relative efficacy of different countdown-checkout plans depends on a large number of the input variables that are arbitrarily fixed. L.S.

N65-31148# Texas A&M Univ., College Station.
ASYMPTOTIC EXPANSIONS OF BESSEL FUNCTIONS BY THE METHOD OF STEEPEST DESCENTS
Larry Herbert Buss (M.S. Thesis) May 1965 52 p refs
(Contract AF 33(608)-1120)
(AD-616714)

A logical development of the Hankel functions is shown, and the asymptotic expansions of the Bessel functions are obtained by the method of steepest descents. Fundamental theorems concerning certain properties of uniformly convergent sequences of functions are proved, and then used to study the analyticity of certain functions expressed as contour integrals. A power series expansion and Hankel's contour integral for the inverse of the gamma function is used to define the Hankel functions as certain contour integrals. It is then shown that these functions are linearly independent solutions of Bessel's equation. An asymptotic expansion is shown as a particular form of a convergent or divergent series, and Watson's lemma is proven. The asymptotic expansions of the Bessel functions are then derived by the method of steepest descents. C.T.C.

N65-31158# Princeton Univ., N. J. Palmer Physical Lab.
TOPICS IN THE THEORY OF RANDOM MATRICES
Burt V. Bronk (M.S. Thesis) Sep. 1964 63 p refs Sponsored in part by AEC and Higgins Scientific Trust Fund
(Contract AT(30-1)-937)
(PUC-1964-153)

The history of the theory of random matrices is reviewed. The reasons why the statistical properties of matrices are of interest for physics are discussed, and various statistical properties of quantum mechanical systems are indicated to show what sorts of properties must be understood. Also, the need for an expression for the density of energy levels of Hamiltonians of complex systems is considered. A relationship is shown to exist between zeros of the classical polynomials and the eigenvalues of random matrices. This relation reflects the sharp cut-off which makes the level density beyond a certain point go rapidly to zero. Further, an exponential ensemble is introduced which permits considerations to be confined to the space of all positive matrices. The joint distribution function for the eigenvalues of these matrices is derived, and a semi-classical derivation based on the Schrodinger equation for the hydrogen atom is used to obtain the single level density formula. E.E.B.

N65-31170# Stanford Univ., Calif. Computer Science Dept.
ON THE MINIMIZATION OF THE NUMBER OF ARITHMETIC OPERATIONS FOR THE SOLUTION OF LINEAR ALGEBRAIC SYSTEMS OF EQUATIONS
V. V. Klyuyev and N. I. Kokovkin-Shcherbak 14 Jun. 1965 27 p Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 5, no. 1, 1965 p 21–33
(CS24; AD-616611)

Any algorithm for solving a general system of n linear equations by means of rational arithmetic operations alone is shown to require at least as many operations (of + or −, and of × or ÷) as does the Gauss single-division scheme of triangularization and back-substitution, i.e. $1/3n(n^2 + 3n - 1)$ multiplications or division, and $1/3n(n - 1/2)(n - 1)$ additions or subtractions. Author

N65-31171# Martin Co., Denver, Colo.
ON PRODUCTS AND QUOTIENTS OF RANDOM VARIABLES
Robert S. De Zur and James D. Donahue Wright-Patterson AFB, Ohio, ARL, Apr. 1965 56 p refs
(Contract AF 33(615)-1023)
(ARL-65-71; AD-616742)

This report, prepared in two parts, deals with products and quotients of random variables. In Part I, the distributions of quotients of independent random variables are considered. In Part II, the distribution of the product of two (not necessarily independent) normally distributed random variates is investigated. The tables of this distribution are given in the Appendix. Author

N65-31193# Illinois Univ., Urbana. Coordinated Science Lab.
GENERAL TOPOLOGICAL ANALYSIS OF LINEAR SYSTEMS
Wai-kai Chen Jan. 1964 65 p refs
(Contract DA-36-039-AMC-02208(E))
(R-191; AD-433495)

The material contained in this thesis can be divided into two major parts: the first part deals with methods of simplification of flow graphs, and the second part deals with general topological analysis of network determinants. Since the linear equations characterizing a system may be expressed as a flow graph, a study of the topological properties of such graphs leads to techniques of simplification. The conditions of separability of a flow graph and the relationship between the bipartite graphs and the flow graphs are also very useful in reaching this goal. It is shown that a general network determinant can be evaluated by means of directed trees and directed 2-trees. There is no sign problem. The products of such directed trees and directed 2-trees will automatically give the correct signs. Furthermore, this new method can be applied to either the node-admittance matrix or the loop-impedance matrix. Some applications of directed linear graphs, such as determining the stability of a system and inverting matrices, are also discussed. Author

N65-31214# Eidgenössische Technische Hochschule, Zürich (Switzerland).
NUMERICAL METHODS FOR THE INVERSION OF LAPLACE TRANSFORMS
Youssef Zaki Boutros (Ph.D. Thesis) Aschmann and Scheller AG, 1964 61 p refs
(PROM.-3491)

The problem of determining the inverse function of a given Laplace transform which is assumed to be analytic in the entire right half plane including the imaginary axis is investigated. The general method of inversion is developed and the application of this method to the problem of the linear flow of heat is discussed. Also, the case where the position, and only the position, of the dominant pole of the transform is known is treated and a practical problem concerning a position control system is completely solved. Further, a program necessary for the practical use of this method on computers is given which is written in the Algol language. E.E.B.

N65-31237# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
SUM RULES IN POTENTIAL SCATTERING, II
K. Chadan Jul. 1965 16 p refs
(TH-196)

Some sum rules were derived for the case of scattering by central potentials of finite radius and were presented in a previous report. This report extends the sum rules to the case of arbitrary central potentials. The essential difference comes from the fact that the potential is always present, independently of its strength, so that the free-wave function is never considered. The new sum rules are relations between the derivative of the phase shift with respect to momentum, and an integral over the whole energy range of a particular combination of the Jost solutions at a given point. Some properties of the different solutions of the Schrödinger equation, as well as some theorems of the theory of entire functions, are also included. These theorems are then used to study the properties of the zeros of the regular solution in the energy plane. The possible connection between the lower bound of the derivative of the phase shift and the asymptotic behavior of the potential is briefly discussed. E.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-30247# Hebrew Univ., Jerusalem (Israel). Dept. of Meteorology.
NUMERICAL STUDIES OF PLANETARY CIRCULATIONS IN A MODEL ATMOSPHERE Final Report
A. Huss Mar. 1965 159 p refs
(Grant AF-EOAR-63-108)
(AFCRL-65-350)

The evolution of general circulation patterns has been studied by means of two-level quasi-geostrophic models. Four different experiments were performed and compared to an earlier experiment in which the basic initial flow was assumed to be constant at each pressure level and the Rossby parameter did not depend on the latitude. The assumptions made in the different runs were respectively: (1) Maximum zonal flow at the central latitude. (2) Maximum zonal flow south of the central latitude. (3) Constant zonal flow at each pressure level and a latitudinal variation of the Rossby parameter. (4) Maximum zonal flow south of the central latitude and a latitudinal variation of the Rossby parameter. The evolving distribution of various field-variables was investigated and compared to the actual distributions observed in the atmosphere. The most significant results were obtained in the third run. Specifically only in this case did the asymmetrical distributions of the field-variables around the central latitude tend to develop in the direction of the asymmetries observed in the atmosphere. Author

N65-30343# Itek Corp., Lexington, Mass.
CLOUD STUDY PROGRAM Final Report, Apr. 1961–Mar. 1965
J. Celi, A. Lanckton, R. J. Ondrejka, and D. I. Harvey 23 Apr. 1965 40 p refs *Its* Rept.-65-9025-1
(Contract AF 19(604)-8467)
(AFCRL-65-314; AD-617747)

This report covers work aimed at the investigation and determination of means for deriving quantitative meteorological data from orbiting satellites. The work was concentrated in two areas: (1) photogrammetric investigations involving satellite photography, and (2) methods for determining radiance data from satellite photography. The problems dealing with cloud photogrammetry and the design of a rectifier for Tiros photography are discussed. Radiometric calibration of the Tiros system and a high altitude aerial camera system are also discussed. Measurements made with these two systems are reported and compared. Recommendations for further work in these areas are presented along with suggested means of improving the accuracy. Author

N65-30449# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
WIND OSCILLATIONS BETWEEN 30 AND 60 KILOMETERS OVER WHITE SANDS MISSILE RANGE, NEW MEXICO
Bruce T. Miers Jul. 1965 19 p refs
(ERDA-312; AD-466999)

Analyses of three series of meteorological rocket soundings have indicated diurnal and semidiurnal cycles in the winds between 30 and 60 km. In general the winds turned clockwise for the periods of time examined, indicating a diurnal cycle

in the wind field. In most cases the amplitude of the diurnal component was larger than the amplitude of the semidiurnal component, with the diurnal component undergoing systematic fluctuations with height. It was found that the diurnal and semidiurnal oscillations were not uniform but occurred in layers of strong and weak oscillations with different phases in the different layers. The largest amplitudes occurred at 45 km where the heating of the ozone by solar ultraviolet is a maximum. Author

N65-30715 Meteorological Office (Gt. Brit.)
ESTIMATION OF RAINFALL USING RADAR—A CRITICAL REVIEW
T. T. Harrold London, HMSO, 1965 59 p refs *Its* Sci. Paper No. 21
(Met.O-767) HMSO: 6s 6d

Progress is reported on investigations on the preparation and properties of fibers and fibrous composites. While these investigations are continuing, additional programs have been undertaken which include the preparation of high modulus continuous filaments, a study of the wetting and bonding of metals to (oxide) whiskers, the development of effective composite fabrication procedures, and the evaluation of composite properties in terms of their potential properties. Current results are summarized from the following programs: (1) development of composite structural materials for high temperature application; (2) wetting and adherence of nickel/nickel-alloys to sapphire; (3) evaluation of sapphire wool and its incorporation into composites of high strength; (4) study of growth parameters involved in synthesizing boron carbide filaments; (5) a survey of the technology of ceramic and graphite fibers and whiskers; and (6) research on high strength, high modulus, low-density continuous filaments of boron carbide. N.E.A.

N65-30836*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT BALDY: AN INVESTIGATION OF AERODYNAMICALLY-INDUCED BALLOON MOTIONS Final Report
R. R. Rogers and H. G. Camnitz 1 Apr. 1965 112 p refs
(Contract NAS8-11140)
(NASA-CR-64334; CAL-VC-1912-P-1) CFSTI: HC $3.00/MF $0.75 CSCL 04B

The character of the erratic motions of several types of balloons was measured and the contribution of these motions to wind measurement error was assessed. Velocity records from approximately 50 ascents were subjected to power-spectrum analysis. The spectra usually extended in frequency from 0 to about 0.3 cps. In many of these there was a marked separation between low frequency components and high frequency components. In such cases it was determined that the high frequency components correspond to erratic motions and the low frequency components are primarily indicative of balloon response to wind variability. Detailed analysis of the apparently erratic velocity components indicated marked differences in the erratic behavior of the different kinds of balloons tested. No significant dependence on meteorological conditions was found, although the results were biased by the requirement of clear weather for the experiments. E.E.B.

N65-31029# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NUMBER 013 (21 JUNE 1965) AND ATHENA FLIGHT NUMBER 014 (22 JUNE 1965) Meteorological Data Report
Harold M. Richart Jul. 1965 91 p refs
(ERDA-327; AD-466440)

Meteorological data gathered for the launching of Athena Flight Number 013, Vehicle #B-002 and Athena Flight Number 014, Vehicle #B-001 are presented for the Air Force Ballistic Missile Re-Entry Systems Office and for ballistic studies. The data are presented in tabular form. Author

N65-31065# Freie Univ., Berlin (West Germany). Institut für Meteorologie und Geophysik.
DAILY AND MONTHLY NORTHERN HEMISPHERE 10-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1964. PART III: JULY–SEPTEMBER Third Quarterly Technical Status Report
Barbara Kriester, Richard Scherhag, and Renate Stuhrmann Dietrich Reimer, 1965 104 p *Its* Meteorol. Abhandl. Vol. 49, No. 3
(Contract DA-91-591-EUC-3288)
(AD-456007) Available from Verlag Dietrich Reimer, Berlin: 15 DM

Daily and monthly 10-millibar synoptic weather maps of the Northern Hemisphere are presented for the period July through September 1964. Also included is a summary of the upper stratosphere circulation for the same period. R.N.A.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-31117* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTRODUCTION TO SST–ATC STUDY PROGRAM
Thomas A. Toll *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 159–160 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

The objectives of the supersonic transport (SST)–air traffic control (ATC) system are defined, and the method to be used is described. A block diagram illustrating the manner in which the equipment both at Langley and at the NAFEC facility are integrated for carrying out the program is given. The simulation program is expected to eventually cover problems in design parameters and operating procedures for the SST, as well as improvements for the ATC system. L.S.

N65-31118* Federal Aviation Agency, Washington, D. C.
EFFECTS OF THE SUPERSONIC TRANSPORT ON THE AIR TRAFFIC CONTROL SYSTEM
Joseph P. O'Brien and Andrew L. Sluka *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 161–170 (See N65-31100 19-02) CFSTI: HC $3.00/MF $1.75

The current joint NASA–FAA simulation program is designed to study problems anticipated in the integration of the supersonic transport (SST) into the present and future Air Traffic Control (ATC) System. The initial tests conducted consisted of simulated departure and arrival operations in the New York terminal area under high-density traffic-flow conditions with as many as six SST operations per hour. Several types of radar and altitude-separation standards and handling concepts were investigated with the present ATC System. Results have shown that for the ATC System, in operations in which the SST was given priority, subsonic traffic incurred excessive radar vectors and excessive holding and ground delays. Further, airport acceptance rates were reduced substantially when the high

separation standards and priority conditions were applied. Present voice communications procedures appear to be adequate for SST operations. Future studies will include other potential designs for the SST, and updating of the ATC system concepts to those envisioned for the time period 1970–1965. Author

N65-31119* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF THE AIR TRAFFIC CONTROL SYSTEM ON THE SUPERSONIC TRANSPORT
Norman S. Silsby, Milton D. Mc Laughlin, and Michael C. Fischer *In* NASA, Washington Conf. on Aircraft Operating Probl. 1965 p 171–181 refs (See N65-31100 19-20)
CFSTI: HC $3.00/MF $1.75

A study of the problems anticipated with the introduction of the supersonic transport into the air traffic control system indicated that supersonic transport design allowances for time and fuel for maneuvering during climbouts may not be sufficient, that there is a greater communications-navigation workload for the supersonic transport than for the subsonic jet transport during descent, and that use of a flight director to command pitch control guidance for the pilot would be helpful. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-30192# Atomic Energy Commission, Washington, D. C. Div. of Reactor Development and Technology.
SUMMARIES OF FUELS AND MATERIALS DEVELOPMENT PROGRAMS
William L. R. Rice Oct. 1964 259 p refs
(TID-6506(Pt. 1)(3rd. ed.)) CFSTI: $6.00

This document comprises the first part of eight parts of the report TID-6506. It includes materials research in the Division of Reactor Development and Technology other than that supported by the reactor project offices in the Division. The classified materials programs and the research supported by the project offices are described. Included in this report are descriptions of contracts negotiated by the U.S.-Euratom Joint Research and Development Board, for which the Fuels and Materials Development Branch serves as technical point of contact in the material area. Other parts of the report include classified research on materials under: nuclear technology—materials; reactors—special features of Naval reactors; nuclear reactors for rocket propulsion; Systems for Nuclear Auxiliary Power (SNAP)—Reactor SNAP Program; advanced concepts for future application reactor; and Military Compact Reactor (MCR). N.E.A.

N65-30195# General Dynamics/Fort Worth, Tex.
DEVELOPMENT AND APPLICATION OF NUCLEAR MEASUREMENT TECHNIQUES Technical Report, 1 Oct. 1963–30 Sep. 1964
W. E. Dungan, J. K. Miles, and J. R. Bell Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965 79 p refs
(Contract AF 29(601)-6213)
(FZK-208; WL-TR-64-160; AD-614109)

A study program was performed on the selection of high-temperature materials for use as passive neutron-field-measuring devices and of thermal-neutron shields for use in extreme nonnuclear environments. Seventeen candidate materials were investigated from which four compounds were selected as most suitable for high-temperature neutron detectors. Also, five high-temperature cements were investigated for possible use as binders in pellet fabrication, and two were found to be acceptable. A limited amount of information is given on the feasibility of replacing cadmium thermal-neutron shields with cadmium oxide shields in high-temperature environments. Facility calibration procedures and results are presented for the modified GTR irradiation chambers, pneumatic tubes, and standard-pile facilities. Also discussed is the interfacility comparison of sulfur-pellet calibrations conducted jointly with three other nuclear facilities. Preliminary results are presented of an experiment performed to reevaluate the counting efficiencies of the NARF end-window counters for commonly used foils. Author

N65-30516# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
WATER REACTIVITY EFFECTS IN THE ANNA CRITICAL ASSEMBLY
Jacek Bouzyk, Jerzy Kubowski, Stanislaw Latek, and Witold Suwalski Feb. 1965 22 p refs
(Rept.-600/IX-A/PR)

The results of reactivity measurements on loss of water from the fuel and graphite /experimental/ channels of the ANNA critical assembly are presented. The shadowing effect, as well as the opposed effect of the water removal from the core and the side reflector, respectively, has been observed. The results are very important for the reactor operation. Author

N65-30517# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
EK-10 DISPERSION FUEL ELEMENTS FOR EXPERIMENTAL AND UNIVERSITY REACTORS
W. Rutkowski, W. Szteke, and M. Wieczorkowski Dec. 1964 30 p refs
(Rept.-585/XIV/R)

In connection with investigation work on dispersion type fuels for experimental and university reactors, it appeared necessary to experiment the technology of EK-10 elements with UO_2-Mg dispersion cores. An informatory batch of such fuel rods was necessary for further testing experiments. In this Report, investigation and production data for the fuel rods mentioned above are described. Author

N65-30568# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
MECHANICAL DESIGN CONSIDERATIONS IN PRIMARY NUCLEAR PIPING
S. W. Tagart, Jr. Washington, AEC, Mar. 1964 119 p refs
(Contract AT(04-3)-189)
(GEAP-4578) CFSTI: $4.00

Stress analysis and design criteria are considered in the review and assessment of mechanical design methods used in nuclear piping. Straight sections of pipe together with flanges, anchors, tees, wyes, and laterals are among the geometries of interest. The adequacy of the rules and methods available to the designer are critically examined from a reliability viewpoint and indicate, among other findings that: (1) the Power Piping Code is incomplete and is frequently misused; (2) adequate analysis methods in the fatigue design of many common components are not available; (3) the loading mechanism associated

with local cyclic thermal stresses has frequently been overlooked; and (4) a general elastic shell analysis tool designed to handle many unsolved problems of local stress analysis has been examined and appears feasible with the use of matrix structural analysis on a large digital computer. C.T.C.

N65-30583# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
NUCLEAR MATERIALS MANAGEMENT: AN ANNOTATED BIBLIOGRAPHY OF SELECTED LITERATURE
Theodore F. Davis and James E. Lovett Aug. 1965 157 p
(TID-3315) CFSTI: $5.00

A total of 845 selected references to unclassified reports and published literature is presented covering all phases of activity in the field of nuclear materials management. An appendix detailing the scope of the field and Personal Author, Report Number and Availability, and Subject Indexes are included. The references given were selected from Nuclear Science Abstracts and cover the period from 1951 to 1964. The references are arranged by reports, journal articles, engineering drawings, patents, translations, and miscellaneous. N.E.A.

N65-30588# Commissariat a l'Energie Atomique, Saclay France.
PREPARATION AND IRRADIATION OF U-UC CERMETS AND OF STOICHIOMETRIC UC [ETUDE DE LA MISE EN FORME ET DE L'IRRADIATION DU MONOCARBURE D'URANIUM]
J. P. Dumas, B. Mansard, and P. Rousset Brussels, EURATOM, 1965 75 p refs
(Contract EURATOM-080-62-3 RDF)
(EUR-2023.F) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 125 Belg. Fr.

Two irradiations were carried out in the Melusine reactor. The maximum irradiation temperature was 1000° C and, despite the low burn-ups reached, two phenomena were pinpointed: (1) In the case of the UC sample containing 2000 ppm of oxygen, a swelling of up to 4% was measured for an integral burn-up as low as 400 MWd/t. (2) In a product containing about 600 ppm of oxygen irradiation up to a burn-up of 140 MWd/t caused contraction in the material containing 4.54 – 4.7% carbon. All the post-irradiation examinations indicate that the irradiated material gradually approaches thermodynamic equilibrium. Parallel studies of fission-gas diffusion by post-irradiation extraction in an out-of-pile loop showed that uranium carbide retained these gases much better than uranium dioxide and that their release between 1400–1900° C was always governed by the diffusion laws. In addition, three experimental devices were developed: an irradiation capsule by means of which UC rods can be inserted straight into the EL-3 reactor; an apparatus for measuring heat-conductivity; and one for measuring electric conductivity. Studies on the preparation of UC by extrusion sintering enabled working conditions to be defined which result in samples of a high density and of a composition near to that of UC. Author

N65-30590# American Chemical Society, New York. Div. of Nuclear Chemistry and Technology.
PREPARATION AND PROCESSING OF PARTICULATE NUCLEAR FUELS
John M. Blocher, Jr., ed. Washington, AEC [1963] 193 p refs
Proc. of Symp. held at New York, 9 Sep. 1963
(CONF-117) CFSTI: $2.00

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8. PREPARATION AND PROPERTIES OF SPHERICAL PARTICULATE NUCLEAR FUELS FOR PLUTONIUM-FUELED REACTORS R. J. Atkins, E. M. Benson, C. S. Caldwell, R. S. Swain, and M. J. Zambernard p 103–126 refs

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11. PROCESSING OF GRAPHITE REACTOR FUELS CONTAINING COATED PARTICLES AND CERAMICS R. E. Blanco, G. I. Cathers, L. M. Ferris, T. A. Gens, R. W. Horton, and E. L. Nicholson p 171–180 refs

12. RECOVERY OF URANIUM FROM PYROLYTIC CARBON-COATED UC_2 SPHEROIDS H. Katz and J. Wagner p 181–193 refs

N65-30591# Nuclear Materials and Equipment Corp., Apollo, Pa.
DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS Progress Report, Jan. 1–Mar. 31, 1964
K. H. Puechl et al [1964] 51 p refs
(Contract AT(30-1)-2389)
(NUMEC-2389-4)

Major efforts during this report were concentrated on mixed oxide sintering studies, preparation of high burnup test specimens, and physical property measurements. These tasks are described in detail in the following sections: (1) preparation and characterization of fuel materials; (2) fabrication and evaluation of fuel shapes; (3) fuel element fabrication and evaluation; (4) radiation testing and evaluation; and (5) plutonium single crystal growth. N.E.A.

N65-30592# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 43, Part A, Oct. 15–Dec. 15, 1964
29 Jan. 1965 79 p refs
(Contract AT(40-1)-2847)
(GEMP-43A) CFSTI: $3.00

Research on fuel elements, reactor materials fabrication, thermocouple and electrical materials, and the effects of radiation on metals and alloys is summarized. Among the studies reported were the following: (1) Laboratory tests of Fe–Cr–Al–Y clad Cr–VO_2 and Fe–VO_2 capsule specimens were made at

950°, 1100°, and 1250° C in air with goals of 10 000 hours. (2) Creep rupture results of arc-cast 0.15-cm diameter molybdenum rods at 2200° C in hydrogen indicated that its strength is not affected by surface-to-volume ratios from 25 to 190. Arc-cast tungsten at 2200° C, and tantalum exposed to hydrogen for 1 hour at 600° C were also tested. (3) Creep-rupture tests were made on irradiated tungsten at 900° C and after annealing at 1700° C, and on irradiated molybdenum at various temperatures. (4) Transmutation effects on the thermoelectric output of the W/W-25 Re thermocouple system were studied, and preliminary tests were conducted to determine the effect of oxygen partial pressure on the electrical resistance of ThO_2. C.T.C.

N65-30595# Atomics International, Canoga Park, Calif.
LARGE SGR CONTROL ROD DEVELOPMENT
M. D. Dermer 25 Jul. 1965 38 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11327) CFSTI: $2.00

A development program was initiated to design, fabricate and test an absorber column with a 10 to 12 year lifetime, for use in the proposed Large Sodium Graphite Reactor (LSGR). The combined shim-safety control rod planned for the LSGR will be a variation of the Hallam Reactor control rod design with the major innovation to be the absorber column. Dysprosium oxide in an annulus formed by an integral tube of Hastelloy-X and a center graphite filler log was chosen as the primary poison material. Full scale elevated temperature testing at reactor profile temperatures gradients simulated approximately 5 years of column lifetime with no adverse effects observed. A prototypical absorber column of this design has been incorporated in the SRE-PEP control rod to gain long term irradiation and operational data to aid in the development of a full scale prototype combined shim-safety control rod for the LSGR. Author

N65-30602# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
ADVANCED, GRAPHITE-MATRIX, DISPERSION-TYPE FUEL SYSTEMS AND RESEARCH ON GRAPHITE Quarterly Progress Report, Period Ending 14 Aug. 1964
J. C. Bokros, W. V. Goeddel, H. K. Lonsdale, R. E. Norman, R. J. Price et al 1 Sep. 1964 36 p refs
(Contract AT(04-3)-167)
(GA-5606, Pt. 1)

Mechanical properties of pyrolytic carbon coatings were investigated for their stability during exposure to high-energy flux. It was found that their flexural modulus and fracture stress decrease with increasing deposition temperature and result in increased elastic strain at fracture. The largest changes occurred in depositions at low temperatures of 1350° and 1450° C, where annealing intensified the described characteristics. Changes through high temperature deposition were minimal. Several pyrolytic carbon samples were prepared for irradiation testing. Calculations of Young's modulus for specimens of plastically deformed pyrolytic carbon showed good agreement with measurements of their preferred orientation. Graphites of high pitch content were hot-worked and their properties are being measured. Tracer diffusion coefficients of thorium in a laminar-type pyrolytic carbon had lower values than those for uranium diffusion. G.G.

N65-30618# Babcock and Wilcox Co., Lynchburg, Va.
IRRADIATION PERFORMANCE OF THORIA-URANIA FUEL MATERIALS Quarterly Technical Report No. 3, 1 Jan.–31 Mar. 1965
[1965] 47 p
(Contract AT(30-1)-3376)
(BAW-3376-3) CFSTI: $3.00

The work accomplished during the report period on the irradiation performance of thoria-urania fuel materials is described. The program is designed to establish, experimentally, particular physical properties of thoria-urania that are of interest to the reactor designer and to present such physical property data in a form suitable for engineering application. The following experimental results were obtained during the report period: (1) the permeability coefficient of compacted UO_2 was measured; (2) the gas flow was identified as a combination of Knudsen and viscous flows; (3) thermal transpiration occurred at atmospheric pressure but decreased at higher pressures; (4) thoria-urania fuel was produced from pure thoria and normal uranium in an application of the sol-gel method; and (5) the sorbed gas release indicated that the gas content of the sol-gel thoria urania is generally less than 0.1 cm^3 per gm. Gas content tended to increase when the urania content was increased. N.E.A.

N65-30619# Atomics International, Canoga Park, Calif.
STUDY OF INSTANTANEOUS COLLAPSE AND CREEP BUCKLING CHARACTERISTICS OF LARGE SGR PROCESS TUBES
M. Lemcoe 25 Jul. 1965 48 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-11323) CFSTI: $3.00

The instantaneous collapse (<0.2 hr) and creep buckling characteristics (up to 5000 hr) of Type 304 stainless steel 4.00 OD by 0.025-in. wall tubes, under external radial pressure and varying axial load, were determined at temperatures up to 1200° F in an inert gas (argon) environment. The length of each tube was 6 ft which, essentially, infinite from a buckling standpoint. In addition, tubes in combination with fuel element bundles corresponding to those proposed for a Large Sodium Graphite Reactor (LSGR) were also investigated to determine the extent to which the fuel element bundle increased the resistance to collapse of the process tube. Ways of increasing the tube resistance to collapse, using stiffener rings, and existing creep buckling theories were also examined. Author

N65-30677# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
MANNED PLANETARY EXPLORATION CAPABILITY USING NUCLEAR PULSE PROPULSION
Paul R. Shipps 19 Mar. 1965 36 p refs Presented at the Canaveral Council of Tech. Soc. 2d Space Congr., 5–7 Apr. 1965
(GA-6224)

The capability of nuclear pulse propulsion in performing manned missions to Mars and other planets using a single stage vehicle is discussed. Descriptive data on a 10-meter nuclear pulse propulsion module design is summarized and a typical complete exploration vehicle using the module is described. Various Mars missions, and major system advantages and systems problems are outlined and discussed. R.N.A.

N65-30678# Oak Ridge National Lab., Tenn.
MOTION OF SPHERES IN SMOOTH ROTATING DRUMS AND APPLICATIONS TO THE COATING OF NUCLEAR FUEL PARTICLES
R. L. Pilloton and H. J. Flamm Aug. 1965 47 p refs
(ORNL-3819)
(Contract W-7405-ENG-26)

This report concerns a process for coating spherical nuclear particles by blowing a coating gas over the charge placed in a heated cylindrical smooth drum, which rotates around a horizontal axis. In such a technique, the control of the particle motion must be precisely adjusted to achieve uniform coating and to avoid the formation of irregular particle shapes or the agglomeration of particles during the coating step. Our investigation has shown that near-spherical nuclear fuel particles will not be properly agitated in horizontally rotating, smooth drums unless loading, rotational speed, and wall-surface characteristics are carefully selected. Furthermore, even when these variables are optimized, the particles remain motionless relative to one another and to the wall for an appreciable fraction of time. This, we conclude that smooth drums are unsuitable for coating. Author

N65-30681# National Reactor Testing Station, Idaho Falls, Idaho.
SPERT PROJECT Quarterly Technical Report, Jan.–Mar. 1965
J. G. Crocker, ed. Jul. 1965 30 p refs
(Contract AT(10-1)-205)
(IDO-17097) CFSTI: $2.00

Preparations for an experimental program with a low enrichment UO_2 rod type core in Spert III and analysis of previous test with a plate type core continued. The analysis includes comparisons of experimental and calculated reactor behavior during transients initiated at high power levels and the development of a technique to obtain short period power excursion tests with thermocouples lacking the required frequency response characteristics. Descriptions of the techniques used and the results of the analyses are presented. The failure of a Spert III primary coolant pump is documentated. In order to obtain information on containment considerations for a Spert IV fuel destruct test, an out-of-pile investigation of capsule materials and designs was initiated. In developing lead rod capsules, tests were performed with cylinders to evaluate the explosive response of various capsule materials, with sealed capsules to determine the effects of containing explosions within closed systems, and to investigate the water hammer effect which resulted from the explosions within the closed capsules and caused the capsules to be raised from their initial test positions. R.N.A.

N65-30714# Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM Quarterly Progress Report, 1 Jan.–31 Mar. 1965
14 May 1965 132 p refs
(Contract AT(10-1)-880)
(IDO-28645) CFSTI: $3.00

Development continued on a mobile low power nuclear power plant for military field operation. The ML-1 power plant was operated for 350 hours. A leak between the process gas system and the shield solution system was discovered and repaired. Data developed in the afterheat experiment was evaluated and the transient temperature prediction computer program was normalized to the experimental results. The permissible fuel element cladding hot spot temperature was revised from 1750° to 1800° F. The design of a partial replacement core was initiated. Fabrication of the alternator continued and the design and fabrication of an improved lubrication system was initiated. The investigation of cladding failure in the IB-17R-3 test element continued. Hot cell examination revealed a small crack in the turbulence promoter section of the cladding. Evaluation continued on the performance limits of Hastelloy X as a fuel element cladding material. Photoelastic stress experiments were conducted to verify design and calculational procedures for a calandria. Optimization of the radiation shielding continued. R.N.A.

N65-30716# General Electric Co., Cincinnati, Ohio. Atomic Products Div.
HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 49, Part A
28 Jul. 1965 82 p refs
(Contract AT(40-1)-2847)
(GEMP-49A) CFSTI: $3.00

Data on fuel element, reactor, and thermocouple and electrical materials research are presented, and the effects of radiation on high-temperature metals and alloys is discussed. Laboratory tests of Fe–Cr–Al–Y clad fuel specimens at 950° and 1100° C indicated excellent stability after 7000 hours. Creep-rupture tests were made on arc-cast tungsten from 1600° to 2800° C, and on arc-cast W–25Re at 2000° C. The W–Re–Mo alloys ranging from W–26Re to W–29Re, with 0, 10, and 20% molybdenum, creep-rupture tested at 1600° C, exhibited a grain refinement as the rhenium content was increased and an increase in grain size as the molybdenum was increased. Additional creep data for arc-cast molybdenum were obtained; the results were similar to those for arc-cast tungsten. Irradiated W–25Re specimens were creep-rupture tested at 800° and 900° C and indicated a significant change in flow properties might be occurring. The thermoelectric properties of Cr, Nb–10Mo, Nb–20Mo, and Nb–40Mo were measured as a function of temperature to 1800° C, and the alloys of Nb–20Mo and Nb–40Mo showed good potential as negative thermoelement materials. C.T.C.

N65-30895# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
RADIATION PROPERTIES OF ^{238}Pu PRODUCED FOR ISOTOPIC POWER GENERATORS
Dean H. Stoddard and Edward L. Albenesius Jul. 1965 23 p refs
(Contract AT(07-2)-1)
(DP-984) CFSTI: $1.00

The alpha, gamma, and neutron radiations associated with $^{238}PuO_2$ produced on a large scale at the Savannah River Plant are presented for evaluation by users of this material as a heat source in isotopic power generators. Author

N65-30907# Battelle Memorial Inst., Columbus, Ohio.
FISSION-FRAGMENT EFFECTS IN STRUCTURAL MATERIALS Quarterly Progress Report, Jan.–Mar. 1965
Robert L. Ritzman, Neal M. Griesenauer, and Edward J. Jablonowski 1 Apr. 1965 8 p
(Contract W-7405-ENG-92)
(BMI-X-10121; EURAEC-1370)

Reactor-grade Type 304 stainless steel and Zircaloy-2 test specimens were prepared and their typical microstructures as received and after annealing are shown. Initial bend specimens were tested to determine their unirradiated properties. Tensile test data of $E = 28.0 \times 10^6$ psi and yield strength = 29,000 psi for annealed stainless steel samples showed good agreement with modified bend-test data. A series of 0.005-in. wall tube-burst specimens was prepared. True stress-strain values for both alloys are presented graphically. Right-circular cylinder and thin disk specimens from both alloys were fabricated, encapsulated, and irradiated by 3×10^{14} or by 3×10^{15} fission fragments per cm^2. Cursory visual examination of the specimens with lower exposure indicated slight strain effects. G.G.

N65-30910# Sandia Corp., Albuquerque, N. Mex.
AEROSPACE NUCLEAR SAFETY. CONTAINMENT CAPSULE IMPACT SAFETY STUDY, PHASE A Progress Report
C. W. Young, C. E. Stoneking, and J. L. Colp Jul. 1965 62 p refs
(SC-RR-65-9) CFSTI: $3.00

The Containment Capsule Impact Safety Study (CCISS) is an experimental study of the relative importance of some parameters affecting the structural integrity of radioisotope containment capsules when they are subjected to impact loading. Series 1 and 2 testing of Phase A (cylindrical capsules), CCISS, has been completed. The effect of L/D ratio and wall thickness on the rupture velocity of cylindrical, closed, partially filled containment capsules was determined. Author

N65-30944# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
ULTRASONIC-INDUCED CAVITATION IN LIQUID METALS AT 500°F
R. Garcia and F. G. Hammit Apr. 1965 8 p *Its* Internal Rept. 05031-3-I
(Grant NSF G-22529)

The accumulative weight loss vs. time, and the accumulative MDP (Mean Depth of Penetration) vs. time for the various materials tested at 500° F were shown. On the basis of MDP the alloy T-111 exhibited the greatest resistance to cavitation. Stress–strain curves and hardness were measured for all of the materials tested at 500° F, and various mechanical properties were computed to correlate these quantities with the cavitation-erosion data obtained at the same temperature. The average MDP rate, various mechanical properties, the rating of the seven materials tested based on the average MDP rate, and the corresponding ratings based on ultimate tensile strength, 0.2% yield strength, and strain energy were summarized. The test temperature of 500° F indicated that the stainless steels were almost as cavitation-erosion resistant as the refractory alloys T-111, T-222, and Mo-1/2Ti. Detailed examination of the 303 stainless steel exponential horn, the 316 container vessel, and the sides of the various test specimens indicated that corrosion effects in the absence of cavitation were negligible. R.W.H.

N65-30984# Interior Dept., Washington, D. C. Geological Survey.
POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES–PRINCIPLES
Arthur M. Piper and Frank W. Stead Mar. 1965 128 p refs Prepared for AEC
(TEI-857) CFSTI: $4.00

Present knowledge of nuclear explosions relating to water resources is summarized, and general criteria are developed by which seemingly favorable areas and sites can be identified. The characteristics of an underground nuclear explosion are discussed and include such topics as nuclear versus conventional explosives; general chronology of a nuclear explosikn; effects in relation to depth of burst; the cavity and features derived from it; and close-in hydraulic effects. It is shown how the natural environment of water is modified by a detonation, and limitations, underground void, draining, discharging a confined water body, and the general characteristics of the throwout crater are among the phenomena considered. Radioactive products of detonation, and their dispersal and decay are also described. C.T.C.

N65-31002# Atomics International, Canoga Park, Calif.
RAPID PULSE HEATING OF MODIFIED ZIRCONIUM-URANIUM HYDRIDES TO DESTRUCTION Final Report
R. A. Finch 25 Jul. 1965 54 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10482) CFSTI: $3.00

Twenty-one samples of modified zirconium-10 wt% uranium hydride were pulse heated to destruction. The experiments were conducted to study the behavioral characteristics of the fuel used in SNAP reactors when the reactors are subjected to severe temperature transients. Data on power input, electrical resistivity, temperature, hydrogen evolution, and thermal expansion during pulses are presented. The duration of these pulses ranged from 28 to 450 msec. H/Zr ratios of the samples varied from 0.50 to 1.81. All of the samples heated uniformly. Initial heating rates were varied from 7000° C/sec to more than 100 000° C/sec. Phase changes were observed to take place in all of the samples. Theoretical predictions of sample failure mechanisms were verified. The gas temperatures after evolution from the samples were determined. Author

N65-31026# Argonne National Lab., Ill.
AN ANALYSIS OF SIX AETR FAST CRITICAL EXPERIMENTS
William G. Davey Mar. 1965 23 p refs
(Contract W-31-109-ENG-38)
(ANL-7014) CFSTI: $1.00

Atomics International has constructed a series of multiregion fast-thermal critical assemblies as part of the Advanced Epithermal Thorium Reactor (AETR) program to obtain data on the physics of U^{233}-Th-fueled reactors. In each case, the central test region was of a composition appropriate to a full-scale core. The physics data obtained in six cores, where the test regions simulated the cores of fairly large fast reactors, have been analyzed using a cross-section set previously used in an analysis of ZPR-III fast critical assemblies. These data are central fission ratios, relative reactivities of certain materials, and the relative importance of neutron sources of different energies. Trends are identified in the differences between calculated and measured data, and these are compared with similar trends found in the ZPR-III assemblies. Author

N65-31045# Argonne National Lab., Ill. Reactor Physics Div.
THEORETICAL ESTIMATES OF PILE-UP DISTORTION
Raymond Gold Mar. 1965 42 p refs
(Contract W-31-109-ENG-38)
(ANL-6949) CFSTI: $2.00

An analysis of pile-up distortion for a (pulse) detector is formulated by means of probability generating functions. Solutions are determined in the form of integral representations. Several important special cases, which are of interest in experimental applications, are treated. The representations for these special cases have been evaluated, and numerical results are presented in both graphical and tabular form. The results of the present method are compared with other estimates of pile-up distortion. Author

N65-31068# Atomics International, Canoga Park, Calif.
SNAP 10A/AGENA ELECTRICAL MOCKUP TEST (S10A/FSEM-2)
M. J. Teresa 17 Jul. 1964 45 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-9893) Available from AEC, Oak Ridge, Tenn.: $1.00
(Declassified)

Presented are the test results obtained while establishing preflight confidence in SNAP 10A and Agena electrical systems. Tests were performed with an electrical mockup of the NPU, designated FSEM-2, and an Agena development test vehicle or functional mockup (FMU). The two mockups were programmed through a simulated sequence of operation from prelaunch to end of life. Author

N65-31145*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMODYNAMIC AND TURBOMACHINERY CONCEPTS FOR RADIOISOTOPE AND REACTOR BRAYTON-CYCLE SPACE POWER SYSTEMS
Arthur J. Glassman Washington, NASA, Aug. 1965 32 p refs
(NASA-TN-D-2968) CFSTI: HC $2.00/MF $0.50 CSCL 10B

This study was made for the purpose of exploring thermodynamic and turbomachinery concepts for low-power (2- to 10-kW) radioisotope and intermediate-power (100- to 300-kW) reactor Brayton-cycle systems. The effects of intercooling and reheating on the system were examined. Turbomachinery characteristics for one single- and two dual-shaft arrangements were determined parametrically as a function of rotative speed and included the effects of varying molecular weight, pressure level, and pressure ratio. Several favorable configurations were selected and presented as examples of geometries suitable for these systems. For a low-power radioisotope system, where the achievement of high cycle efficiency is of prime importance, the maximum increase in cycle efficiency achievable by the use of both intercooling and reheating was about 0.05 out of a total of about 0.35 to 0.40. For a typical intermediate-power reactor system, where the achievement of minimum radiator area is of prime importance, intercooling offers no area reduction but reheating results in about a 15 percent reduction in minimum area. Author

N65-31150# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center.
U. S. REACTOR CONTAINMENT TECHNOLOGY. A COMPILATION OF CURRENT PRACTICE IN ANALYSIS, DESIGN, CONSTRUCTION, TEST, AND OPERATION, VOLUME I
William B. Cottrell and A. W. Savolainen, ed. Aug. 1965 712 p refs Prepared jointly with Bechtell Corp.
(Contract W-7405-ENG-26)
(ORNL-NSIC-5, Vol. I) CFSTI: $14.00 (Vol. I and II)

Volume I of a compilation of information on reactor containment technology is presented and includes pertinent regulations and existing criteria, the nature and scope of accidents that are examined for every reactor in order to identify the accident that is considered the maximum credible for that reactor and which determines the containment requirements, the energy products that must be contained, the energy that the containment system must be designed to cope with, and a summary of the special analytical techniques involved in containment analyses. R.N.A.

N65-31151# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center.
U. S. REACTOR CONTAINMENT TECHNOLOGY. A COMPILATION OF CURRENT PRACTICE IN ANALYSIS, DESIGN, CONSTRUCTION, TEST, AND OPERATION, VOLUME II
William B. Cottrell and A. W. Savolainen, ed. Aug. 1965 677 p refs Prepared jointly with Bechtel Corp.
(Contract W-7405-ENG-26)
(ORNL-NSIC-5, Vol. II) CFSTI: $4.00 (Vol. I and II)

Volume II of a compilation of information on reactor containment technology is presented and includes descriptions of existing containment systems, design considerations, auxiliary components, required performance tests, identifiable costs associated with various containment systems and components, and a resume of current research pertinent to all aspects of containment. R.N.A.

N65-31152# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
THE EFFECT OF MESH SIZE ON NUMERICAL CALCULATION OF POWER PEAKING
Gerald P. Calame Aug. 1964 16 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6198)

The error resulting from the replacement of the diffusion equation by a finite difference equation in two region power peaking calculations is examined. The error is tabulated for a range of material compositions and mesh spacings. It is found that the error is small where the ratio of the mesh spacing to the diffusion length is the same in each region. Author

N65-31160# Battelle Memorial Inst., Columbus, Ohio.
POSTIRRADIATION FISSION-PRODUCT RELEASE FROM COATED PARTICLES
Harvey S. Rosenberg, David L. Morrison, Charles W. Townley, and Duane N. Sunderman 7 Jul. 1965 54 p refs
(Contract W-7405-ENG-92)
(BMI-1734) CFSTI: $1.25

For PyC-coated particles, the release of Ba^{140}, Sr^{89}, and Ag^{111} was greater than 1000 ppm, the release of Te^{132}, I^{131}, Ce^{141} and Nd^{147} was between 10 and 1000 ppm, and the release of Xe^{133}, Ru^{103}, and Zr^{95} was less than 10 ppm for 6 hr of annealing at 1150° C. At a constant coating density the Ba^{140} release was lowered by about two orders of magnitude as the thickness of the PyC coating was increased from 30 to 75μ, and at a constant coating thickness the Ba^{140} release was lowered by about one order of magnitude as the coating density was increased from 1.5 to 2.0g per cm^3. The Ba^{140} release was lowered by three orders of magnitude when a SiC barrier layer was present in the PyC coating. The release rate is increased by a factor of about six for each 150° C increase in temperature between 1000° and 1300° C. The mechanism of release is thought to involve diffusion and compound formation between the fission-product elements and the particle coating. The apparent diffusion coefficients in one type of PyC at 1150° C are 9×10^{-9} cm^2 per sec for Sr^{89}, 6×10^{-10} cm^2 per sec for Ba^{140}, 5×10^{-11} cm^2 per sec for Nd^{147}, and 1.5×10^{-11} cm^2 per sec for Ce^{141} Author

N65-31217# Atomics International, Canoga Park, Calif.
PRELIMINARY SNAPSHOT—1 PERFORMANCE Summary Report
R. M. Galantine, ed. 1 Aug. 1965 95 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-11430)

The SNAP 10A power system is the first thermoelectric, direct power conversion system for space application using a nuclear reactor as the heat source. This report presents the preliminary evaluation of test results from the SNAPSHOT flight test. The SNAP 10A/Agena spacecraft was launched into a near circular, polar orbit at 13:24 PST on April 3, 1965. On May 16, 1965, after 43 days of continuous operation, premature shutdown of the SNAP 10A system occurred. The program has demonstrated that reactor space power systems can be integrated into a typical spacecraft, that the factory-through-flight sequence can be routinely programmed, that no special ground handling equipment or launch base procedures are necessary, that safety questions can be handled

in an objective manner, and that public acceptance of nuclear power in space is readily obtainable. The flight provided information on the effects of hard vacuum and zero-gravity operation, verification of component performance and methods of predicting performance in space using ground test data, radiation shielding, the effective neutron source strength of space, and related technical data. Author

N65-31219# Atomics International, Canoga Park, Calif.
PERMEATIONS OF HYDROGEN THROUGH METALS
R. W. Webb 25 Jul. 1965 24 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10462) CFSTI: $2.00

The permeability of hydrogen through those metals being considered for use in SNAP reactor systems must be known in order to predict hydrogen mobility and migration in the NaK primary coolant system of the reactors. Of particular concern is the amount of hydrogen which will migrate into the mercury boiler loop. Data were gathered from the literature on the flux of hydrogen gas permeating various metals, and experiments were made with a hydrogen-sensitive mass spectrometer to collect additional data. The high-pressure data were fitted to the equation

$$\frac{\psi}{x} = CP^{1/2}\exp\left(\frac{-Q}{RT}\right),$$

which relates the flux to the hydrogen pressure, the metal thickness, and the activation energy for diffusion. Author

N65-31220# Argonne National Lab., Ill. Reactor Physics Div.
NEUTRON-FLUX STUDIES IN THE EBWR DURING POWER OPERATION
W. G. Knapp Mar. 1965 43 p refs
(Contract W-31-109-ENG-38)
(ANL-6751)

The neutron-flux distribution in the Experimental Boiling Water Reactor (EBWR) core during power operation has been studied through the use of activation foil detectors. The method described in ANL-7011 was used for irradiation and analysis of the detectors. From data obtained with bare and cadmium-covered, cobalt-aluminum alloy foils, neutron-flux isogram plots have been prepared. The effects of reactor power changes, soluble-poison concentration, and control rod positions on the thermal and resonance neutron-flux distribution are shown. Author

N65-31223# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
SPORT: A SYSTEM FOR PROCESSING REACTOR TRANSIENT DATA ON THE IBM-7040 COMPUTER
B. J. Power, R. N. Hagen, and S. O. Johnson Jul. 1965 211 p refs
(Contract AT(10-1)-205)
(IDO-17078) CFSTI: $6.00

To facilitate the processing and analysis of data recorded during transient tests in the Spert reactors, a system of programs for the IBM-7040 computer has been developed to (a) smooth and store data so they are readily accessible, (b) calculate from the power history the reactivity and energy release as functions of time, and (c) provide a means by which frequency response analyses of data can be made. This report describes the mathematics employed in the various programs in the system and the procedures necessary to process data with the system. Test and sample problems are presented, and a complete listing of the source program is included. Author

N65-31240# European Space Vehicle Launcher Development Organization, Paris (France).
SPACE APPLICATIONS OF NUCLEAR ENERGY
J. P. Contzen Oct. 1964 59 p refs
(ELDO-TM-F-6)

This paper attempts a comprehensive survey of the possible applications of nuclear energy in space. Propulsive applications are dealt with first: nucleo-thermal propulsion, nuclear electric propulsion and nuclear particle propulsion are analysed in general terms. The section dealing with non-propulsive applications is chiefly devoted to the problem of auxiliary electrical power generation on board space vehicle; the discussion turns mainly on power sources and conversion systems. The paper also attempts to define the orientation which could be given to European research in this area. Author

N65-31244# Argonne National Lab., Ill. Reactor Physics Div.
SOME PHYSICS ASPECTS OF THE PLUTONIUM EXPERIMENT IN EBWR
B. J. Toppel and R. Avery Apr. 1965 38 p refs
(Contract W-31-109-eng-38)
(ANL-7019) CFSTI: $2.00

Survey calculations are given which will permit the observation of the effects of major parameter variations such as plutonium zone, plutonium zone enrichment, and composition of driver zones (if any) in plutonium fueled, light-water-moderated reactors. An experiment evolved from the survey calculation results is also briefly outlined. The calculational methods take into consideration geometry, composition, cross-section prescription, and codes utilized. Loadings of one, two, and three core zones were considered, and the properties of each system were determined. Results are given in tabular form and include data on initial reactivity coefficients, control rod effects, isotopic density, time behavior of the reactivity, and influence of burnup on various reactivity coefficients. Among the results indicated by the survey are: (1) The most favorable system is the three-zone type with an initial enrichment in the range of 0.025 for the plutonium region. (2) The control problem in long-term reactivity swings might be serious in loading. C.T.C.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-30400# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS Collection of Articles
8 Feb. 1965 276 p refs Transl. into ENGLISH of Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 5, Sep.–Oct. 1963 p 1–160
(FTD-MT-64-61; AD-614773)

Selected articles on electronics, thermodynamics, nuclear physics, structural mechanics, and magnetohydrodynamics are presented. For individual titles see N65-30401–N65-30430.

N65-30524*# American Machine and Foundry Co., Alexandria, Va.
STUDY AND DESIGN OF MULTIPLE OR STACKED DETECTORS AND A SINGLE FIXED DETECTOR Bimonthly Progress Report No. 1
Dec. 1964 12 p
(Contract NAS9-3587)
(NASA-CR-65080) CFSTI: HC $1.00/MF $0.50 CSCL 20F

To provide simultaneous detection of a complete diffraction pattern, theoretical and experimental evaluations of several detectors were conducted to determine their performance in an integrated diffractometer system. Such characteristics as resolution, efficiency, sensitivity, counter voltage, readout, vacuum, price, ruggedness, and temperature were compared, and the results tabulated. Two detectors, the X-ray vidicon and the multichannel geiger counter, were selected as offering the most advantageous approaches to the problem. In a study of X-ray diffraction camera arrangements, both non-focussing and focussing types were considered, and an X-ray focussing camera was designed and fabricated. Electronic data processing and readout circuitry were selected for the geiger counter approach. W.M.R.

N65-30579# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TEMPORAL DISTURBANCES IN INTERFEROMETRIC SPECTROSCOPY
William Paul Chandler (M.S. Thesis) Mar. 1965 132 p refs
(SP/PH/65-6; AD-616685)

A study of temporal disturbances in interferometric spectroscopy is presented. Four types of disturbances were studied: (1) interferometer noise; (2) harmonic modulation of the source intensity; (3) broad band noise modulation of the intensity; and (4) broad band noise vibrations of the interferometer. In chapter two, the basic theory of the two beam Michelson spectral interferometer is presented, followed in chapter three by the two principal methods of reducing the interferogram into its basic frequencies. Chapter four is a discussion of the interferometer system and equipment, and the different modes of operation. Chapter five is the calibration of the interferometer system. Chapter six uses the calibration information from the previous chapter, and develops the theory of obtaining the absolute spectra of an unknown source. Chapter seven defines and discusses the four types of disturbances, while chapter eight discusses the data reduction theory and assumptions. Chapters nine through twelve cover the measurements and the results of the four disturbances. The discussion of results, conclusions, and recommendations are given in the remaining chapters. N.E.A.

N65-30582# Weapons Research Establishment (Australia).
THE VARIATION OF THE OPTICAL TRANSMITTANCE THROUGH THE ATMOSPHERE WITH ALTITUDE AND SIGHTLINE ELEVATION
D. J. Gambling May 1965 15 p refs
(WRE-ISD-TN-59)

The optical transmittance through the atmosphere is determined as a function of the altitude and sightline elevation using published values of the attenuation coefficient. The results obtained are expected to be slightly lower than actual average as the scattering coefficients used in the calculation were obtained on days of lower than average visibility. Further studies of the variation of the scattering coefficient with time of year and at greater altitudes would yield more extensive results. N.E.A.

N65-30633# California Univ., Berkeley. Dept. of Physics.
THE STREAMER SPARK IN ASYMMETRICAL FIELD GAPS
Leonard B. Loeb [1965] 52 p refs
(Contract Nonr-295(11))
(TR-98; AD-616990)

Secondary streamers are shown to be real entities which start as the primary advances well into the gap, and are the result of an ionizing space wave launched from the anode region through action of the high anode potential on the inflowing electrons from the primary streamer. Branching is shown to be controlled by photoionization from the streamer tip. Lichtenberg figure tracks are smoothed by a long, slow potential decline in which continued current flow obliterates discontinuities. The light flashes observed when streamers strike the cathode are discussed. The zero field streamer theory is analyzed. Return strokes are proven to be fairly certain. TAB

N65-30659# RAND Corp., Santa Monica, Calif.
SATELLITE-BASED DETECTION OF THE ELECTROMAGNETIC SIGNAL FROM LOW AND INTERMEDIATE ALTITUDE NUCLEAR EXPLOSIONS
William J. Karzas and Richard Latter Jun. 1965 14 p refs
(Contract AF 49(657)-9619-SA3)
(RM-4542; AD-616701)

A theoretical examination of satellite-based detection of electromagnetic signals produced by nuclear explosions at low and intermediate altitudes (a few to 20 or so kms). Since such explosions are particularly difficult to detect, the Memorandum suggests that this promising detection technique be included in the Project VELA satellite. Author

N65-30670# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SYNTHESIS OF ARBITRARY-AXIAL-MAGNETIC FIELDS WITH STANDARD COILS
David B. Taylor (M.S. Thesis) Jun. 1965 122 p refs
(GSP/PH/65-18; AD-616690)

A method to synthesize an axial-homogeneous field is presented in which any number of standard coils may be positioned so as to describe any arbitrary magnetic field. The fields of standard coils described by

$$B_n = A_5 / (A_1 + A_2Z^2 + A_3Z^4 + A_4Z^6)^{1/2}$$

are fit to a predetermined field by the method of least squares. Computer solutions predict a ripple along the axis of 1.25 percent for 13 coils over 2.26 meters. Experimental tests verify the solution. Off axis ripple is predicted by the equation

$$B(r,o) = C_1 I_o (2\pi r/l_o)$$

which holds for constant fields. Computer codes to solve the entire problem are presented in the appendixes. Author

N65-30672# Rochester Univ., N. Y. Inst. of Optics.
BASIC RESEARCH IN OPTICS Final Report, Feb. 1, 1963–Jan. 31, 1965
K. Teegarden [1965] 5 p refs
(Grant AF-AFOSR-236-63)
(AD-616682)

A brief summary is given of research projects concerning various optical phenomena in solid rare gases and in alkali halides. TAB

N65-30679# Southampton Univ. (England). Inst. of Sound and Vibration Research.
A STUDY OF PRESSURE WAVES IN A PIPE WITH REFERENCE TO INTERNAL COMBUSTION ENGINE EXHAUST SILENCERS

M. J. Dwyer Aug. 1964 58 p refs
(ISAV-114)

A theoretical and experimental study of the transmission of compression waves through various elements of conventional silencers is reviewed. It was found that the only effective method of reducing the amplitude of compression waves in a pipe was by means of changes in cross sectional area. The present study consists of a more detailed investigation of pressure waves in pipes with changes of cross sectional area, considering reflected as well as transmitted waves and using a range of incident compression waves up to a pressure ratio of 2. The experimental results are compared with theory and fairly good agreement was found. Schlieren photographs of shock waves in a duct with changes of cross section helped to explain some of the discrepancies which were found. E.W.

N65-30686# Naval Research Lab., Washington, D. C.
SYSTEMATIC ERRORS IN ULTRASONIC PROPAGATION PARAMETER MEASUREMENTS. PART 2: EFFECTS OF GUIDED CYLINDRICAL MODES
V. A. Del Grosso 29 Jan. 1965 131 p refs
(NRL-6133; AD-616996)

In the present report it is shown that appreciable errors in the measurement of sound speed and sound absorption for guided mode propagation may be attributed to neglect in applying corrections that may be required because of the selection of geometric parameters or the method of measurement. This report contains graphs of pressure and phase, relative to plane-wave values and averaged over a plane-parallel receiver of size equal to the source size, for acoustic energy propagation down a right-circular liquid cylinder with lateral boundary condition appropriate to one of the following: absolutely rigid walls, infinitely flexible walls, liquid walls, or elastic solid walls. The latter boundary condition, which is considered to be that most appropriate to the situation of a liquid contained within a thick-walled metal tube, is shown to result in maximum anomalies in sound speed determinations when the transducer completely closes one end of the tube. Author

N65-30754# Technical Operations Research, Burlington, Mass.
OPTICAL STUDIES OF PARTIALLY COHERENT DIFFRACTION AND THE ERGODIC HYPOTHESIS Final Report, 15 Jul. 1964–15 Jan. 1965
George O. Reynolds and David G. Etsell 30 Apr. 1965 79 p refs
(Contract AF 19(628)-4320)
(AFCRL-65-152; AD-614807)

Diffraction by apertures illuminated by partially coherent light, diffraction by apertures containing random phase disturbances, experimental demonstration of the ergodic hypothesis, and the concept of cross spectral purity are considered. In diffraction experiments using partially coherent illumination, it is observed that as the ratio of aperture size to coherence interval increases (i.e., the illumination becomes less coherent) the sharp minima present in the diffraction pattern disappear and a shifting of the minima occurs. The results are compared with existing theories, and the agreement is excellent. It is experimentally shown that random phase disturbances placed in the diffracting aperture distort an individual diffraction pattern. In the corresponding ensemble-averaged experiment, the distortion is reduced and the diffraction pattern is more readily identified. The ensemble-averaged results agree quantitatively with theoretical calculations. In investigating the concept of cross spectral purity, it is shown that quasi monochromaticity is synonymous with spectral purity and that spectral impurity is synonymous with polychromaticity. Author

N65-30766# Air Force Cambridge Research Labs., Hanscom Field, Mass.
GUIDE TO THE INTERPRETATION OF SPACE GROUP SYMBOLS
Stanley K. Dickinson, Jr. Apr. 1965 33 p refs *Its* Phys. Sci. Res. Papers No. 98
(AFCRL-65-279; AD-616246)

A scheme for presenting and interpreting the 230 space groups is developed. The scheme is based on the addition of symmetry operations to translation operations in conformance with the symmetry requirements of the seven crystal systems. The stepwise development from crystal systems to space groups is traced in the report and centerfold chart. Complete notes on deciphering the space group symbols and for correlating the Schoenflies and the International systems of abbreviations are included as appendices. Author

N65-30772# California Univ., La Jolla.
SELF-CONSISTENT EQUATIONS INCLUDING EXCHANGE AND CORRELATION EFFECTS
W. Kohn and L. J. Sham 17 Jun. 1965 21 p refs
(Contract Nonr-2216(11))
(TR-31; AD-616759)

From a theory of Hohenberg and Kohn, approximation methods for treating an inhomogeneous system of interacting electrons are developed. These methods are exact for systems of slowly varying or high density. For the ground state, they lead to self-consistent equations analogous to the Hartree and Hartree–Fock equations, respectively. In these equations the exchange and correlation portions of the chemical potential of a uniform electron gas appear as additional effective potentials. (The exchange portion of our effective potential differs from that due to Slater by a factor of 2/3.) Electronic systems at finite temperatures and in magnetic fields are also treated by similar methods. An appendix deals with a further correction for systems with short wave-length density oscillations. Author

N65-30778# Rochester Univ., New York. Dept. of Physics and Astronomy.
THEORETICAL STUDIES OF EFFECTS OF COHERENCE IN ELECTROMAGNETIC RADIATION Final Report, 1 Mar. 1963–28 Feb. 1965
Emil Wolf Mar. 1965 18 p refs
(Grant AF-AFOSR-237-63)
(AD-616547)

The results of the investigations on the effects of coherence in electromagnetic radiation are given in twenty papers published in various scientific journals. Titles and authors of these papers are listed. Summaries of the papers, which record the main results obtained are given. In addition, some of the results were also presented in a number of papers given at various scientific conferences and in lectures given at various Universities and Laboratories. These are listed. A list of the personnel which assisted in this research is given. TAB

N65-30825# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A PROGRAM FOR THE ESTIMATION OF POWER SPECTRA
C. R. Arnold and E. Korngold 21 May 1965 50 p refs *Its* Tech. Note 1965-16
(Contract AF 19(628)-500)
(ESD-TDR-65-75; AD-616677)

A Fortran II program of spectral analysis was written, and is described. The analysis is valid for sequences of equidistant data sampled from realizations of second order stationary stochastic processes. Alternatively, the program may be used to estimate the transfer function gain characteristics of a linear system on the basis of its sampled output. The inputs to the

program consist of the data sequence to be analyzed and four control parameters. The output consists of listings of the estimated values, and listings of three plots of the sample auto covariance functions, the power spectral density (PSD), and a log-log plot of the PSD. The parameters critical to a power spectral analysis are discussed, the program is described, and operating instructions are given. Also described are possible modifications to the program. L.S.

N65-30871# Autonetics, Anaheim, Calif.
ELECTRO-OPTIC PROJECTION STUDY Final Report, Dec. 1963–Dec. 1964
R. S. Stites, W. E. Meyer, and C. L. Buddecke Griffiss AFB, N. Y., RADC, Apr. 1965 137 p refs
(Contract AF 30(602)-3263)
(RADC-TR-65-25; AD-617087)

This study had as its objective the investigation and evaluation of an image projection technique which utilizes the longitudinal Pockel's effect for light modulation. The light valve tubes used in the study employ an electron beam to develop discrete electric fields through an electro-optic material. These fields induce an optical birefringence in the material which is transformed into proportional intensity modulation of a light beam. Characteristics of two electro-optic materials, potassium dihydrogen phosphate and potassium dideuterium phosphate, were measured in order to optimize the design of the light valve tube. The device was fabricated and demonstrated an ability to project live television imagery. Operating parameters were determined for use in synthesizing an image projection system capable of presenting bright, large scale dynamic displays for command and control applications. Author

N65-30884# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
THE FORCE DENSITY IN POLARIZABLE AND MAGNETIZABLE FLUIDS
L. J. Chu, H. A. Haus, and P. Penfield, Jr. 1 Jun. 1965 42 p refs
(Contract DA-36-039-AMC-03200(E))
(TR-433; AD-617109)

The force density in polarizable and magnetizable fluids in nonuniform motion is evaluated in a way that is consistent with the special theory of relativity. The derivation is based on a generalization of the principle of virtual work. For application of the principle, it is necessary to know the energy density and power-flow density in a local rest frame of the fluid element under consideration. These are obtained from thermodynamic information and an extrapolation of the Poynting theorem applied to a rigid, nondeforming medium. Two different formulations of electrodynamics of moving and deforming media are compared. It is shown that they lead to the same force density if the same thermodynamic information is used in each of them. A simple model for the force density is obtained, starting from the E-H formulation. Author

N65-30885# Harry Diamond Labs., Washington, D. C.
PROPERTIES OF AN ACTIVE OPTICAL SYSTEM
Robert G. Humphrey 30 Apr. 1965 36 p refs
(HDL-TR-1281; AD-617069)

An active optical configuration is described that permits high-precision detection of targets at a predetermined range. Sources of high radiance are required and the degree of range precision obtainable depends on the availability of high performance components. The detection system has a limited range of sensitivity in the region where target detection is required. By making this range of sensitivity small, the system can be made insensitive to natural fog and clouds for short range applications. A geometric analysis is made of the system's clear weather performance. Additional analysis indicates performance in fog. Some applications are suggested. Author

N65-30973# American Meteorological Society, Boston, Mass.
REDUCTION OF THE DIRECT PRODUCT OF REPRESENTATIONS OF THE PROPER HOMOGENEOUS LORENTZ GROUP [PRIVEDENIE PRIAMOGO PROIZVEDENIIA PREDSTAVLENII SOBSTVENNOI ODNORODNOI GRUPPY LORENTSA]
I. B. Levinson and A. P. Iutsis Bedford, Mass., AFCRL, Apr. 1965 20 p refs Transl. into ENGLISH from Tr. Litovsk. Akad. Nauk, Ser. B (Vilna), v. 4, no. 16, 1958 p 3–16
(Contract AF 19(628)-3880)
(T-R-328; AD-616679)

The reduction of the direct product of any number of finite-dimensional representations of the proper homogeneous Lorentz group is examined. It is shown that the corresponding generalized Clebsch–Gordan coefficient is expressed in the general case by the sum of the products of two factors, one of which is the generalized Clebsch–Gordan coefficient for representations of a group of three-dimensional rotations, while the other is the j-symbol whose number of parameters is $3(2r - 1)$, where r is the number of factors in the corresponding direct product. It is shown by direct calculations that with some simplification this j-symbol is expressed by the product of 9 j symbols, the number of which is equal to $r - 1$. The authors give the properties of symmetry of the ordinary Clebsch–Gordan coefficient (the case of the product of two representations) for Lorentz group representations, which they also use to express generalized Clebsch–Gordan coefficients. Author

N65-30977# California Univ., Berkeley. Inst. of Engineering Research.
PLASTICITY THEORY AND MULTIPOLAR CONTINUUM MECHANICS
A. E. Green (Newcastle upon Tyne Univ.) and P. M. Naghdi Mar. 1965 15 p refs
(Contract Nonr-222(69))
(AM-65-3; AD-617168)

In this paper, it is shown that the nonlinear theory of an elastic-plastic continuum in the form developed by Green and Naghdi (1965) may also be deduced as a special case of the theory of multipolar continuum mechanics (green and Rivlin, 1964). Author

N65-30979# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME I, NO. 8 A Monthly Review of Selected Foreign Scientific and Technical Literature
Aug. 1965 74 p refs

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N65-31010# Philipps Universität, Marburg (West Germany). Institut für Theoretische Physik.
FLUCTUATION IN GASES. MATHEMATICAL PROBLEMS IN QUANTUM FIELD THEORY Final Report
G. Ludwig 1 Jan. 1965 76 p refs
(Grant AF-EOAR-61(052)-658)
(AFOSR-65-0652; AD-616782)

The derivation of the Boltzmann equation in μ-space including a study of the influence of binary correlations on the collision term is presented. Also, a further improvement of the derivation of the master equation for binary collisions is demonstrated, and the behavior of the solutions of the ζ-equation for two simple boundary problems is considered. Further, research on symmetry groups; S-matrix approach to electron-pion scattering; and an axiomatic approach to field theory are discussed. E.E.B.

N65-31169# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
[SOLID STATE; ELECTROMAGNETIC THEORY AND PLASMAS; INFORMATION SCIENCES] Consolidated Semiannual Progress Report, Oct. 1964–Mar. 1965
D. B. Wittry et al [1965] 138 p refs
(Contracts AF 04(695)-537; AT(11-1)-113; N123-60530)-52008A; Grants AF-AFOSR-76-63; AF-AFOSR-188-65 et al (SAPR-1; AD-616710)

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N65-31248# New York Univ., N. Y. Dept. of Physics.
INTRODUCTION TO THE DENSITY MATRIX
A. E. Glassgold [1964] 63 p refs
(Contract Nonr-285(58)
(N65-1; AD-616555)

The general properties of the density matrix are summarized and illustrations are given of a variety of simple, useful examples. The density matrix is a quantum mechanical answer to the general question of how to describe physical systems when less than the desired information is available. According to this discussion, measurements on a quantum mechanical system, whether in a definite quantum state or not, may be described in terms of a representative statistical ensemble. How this ensemble is efficiently characterized by the density matrix is the main theme of this analysis. E.E.B.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-30444# Army Nuclear Defense Lab., Edgewood Arsenal, Md.
A LISTING OF CINDA, AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA
Herbert Goldstein (Columbia Univ.) and Malvin H. Kalos (New York Univ. and United Nucl. Corp.) 1 Jul. 1964 792 p
(UNC-5090; NDL-SP-10; DASA-1535; AD-607668)

A bibliographical index of information is presented concerning microscopic neutron cross sections and allied data for specific elements and isotopes and referred to as CINDA (Computer Index Neutron Data). Both published and unpublished literature since the beginning of 1956 is covered. The references are mostly concerned with neutron cross section measurements but also included are theoretical calculations, cross section evaluations, and compilation insofar as they refer to specific target nuclei. R.N.A.

N65-30450*# AVCO-Everett Research Lab., Everett, Mass.
[ATOMIC LINE AND KRAMER'S RADIATION. RADIATION TABLES] Final Progress Report
Jul. 1965 32 p refs
(Contract NASw-748)
(NASA-CR-64170) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Progress is reported on radiation studies performed at AVCO-Everette Laboratory. The studies include: (1) measurements of Kramer's radiation made behind incident and reflected shocks in an electric-arc driven shock tube having a driven section 30 feet long and six inches in diameter; and (2) measurements of atomic line and background radiation in the vicinity of 7500 A. An abstract is also included in the report on Part II of the radiation tables completed during the study. N.E.A.

N65-30459*# California Univ., Berkeley. Space Sciences Lab.
MEASUREMENTS OF MASS AND MOMENTUM FLUX IN NON-IDEAL MOLECULAR BEAMS
R. G. Lord and F. C. Hurlbut 12 Feb. 1965 46 p refs *Its* Ser. No. 6, Issue No. 3
(Grant NsG-243-62; Contract Nonr-222(45)
(NASA-CR-64217) CFSTI: HC $2.00/MF $0.50

Molecular beams formed by effusion through an orifice whose size is of the same order as the mean free path in the source chamber are nonideal in the sense that the effects of intermolecular collisions in the beam are not negligible. The properties of such beams have been investigated by measuring, over a wide range of source conditions, the normal momentum transferred from the beam to a diffusely reflecting test surface mounted on a sensitive torsion balance. The perturbation of the measured force on the test surface from its ideal free molecule value is interpreted in terms of the mass and momentum flux perturbations in the beam and compared with the predictions of recent theories. A substantial discrepancy is noted between the calculated and measured perturbations. These experiments have demonstrated the feasibility of making absolute measurements of momentum transfer in particle-surface interactions. Author

N65-30463*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

CORE AND REPULSION INTEGRALS FOR LOWDIN ORTHOGONALIZED ATOMIC ORBITALS IN Pi-ELECTRON SYSTEMS

D. P. Chong 3 Jun. 1965 18 p refs

(Grant NsG-275-62)

(NASA-CR-64130; WIS-TCI-102) CFSTI: HC $1.00/MF $0.50

The core integrals and electron repulsion integrals for the $2p\pi$ Slater-type orbitals of the allyl radical, trimethylenemethyl radical, and benzene molecule have been transformed to the corresponding Löwdin orthogonalized basis set of atomic orbitals. All the transformed multi-center non-Coulomb repulsion integrals are found to have reduced in magnitude. Author

N65-30502# Naval Radiological Defense Lab., San Francisco, Calif.

STRUCTURE IN THE Al^{27} (n,α) CROSS SECTION

J. M. Ferguson 6 May 1965 9 p refs

(USNRDL-TR-846; AD-463919)

The excitation function for the Al^{27} (n,α) cross section was measured from 12.8 to 14.3 Mev. The energy resolution of the data is better than 80 kev, and the statistical errors are less than 1 percent. The data show a peak at 13.55 Mev in the cross section with a width of about 300 kev and an amplitude of about 4 percent of the average cross section in this region. Author

N65-30515# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

THE USE OF THE CHOPPER FOR PULSE NEUTRON MEASUREMENTS

A. Graffstein, Z. Ogrzewalski, T. Rzeszot, and E. Warda Apr. 1965 14 p refs Presented at the Symp. on Pulsed Neutron Res., Karlsruhe (West Germany), 10–13 May 1965

(Rept.-624/IX-A/R)

The diffusion parameters of the organic glass have been measured using pulse neutron technique. A neutron pulse introduced into the moderating medium of certain dimensions (geometrical buckling) generates time dependent neutron flux, the asymptotic decay constant of which is measured. As a neutron detector the BF_3 miniature proportional counter has been used in typical amplifying and supplying electronic equipment. The pulses from the counter were recorded by the 256-channels time analyser of At-4 type using channel width of 4–16 μs. The exponential decay curves were elaborated by means of digital computer GIER. The chopper operating at the horizontal channel of the EWA reactor has been used as a pulse neutron source. The rotor of the chopper is constructed of the steel and its diameter is 43 cm. The rotor was rotated at a speed of 6.000 rpm. The width of the neutron pulse was about 160 μs and the repetition rate of 200 sec^{-1}. The investigated sample was placed before the rotor slit. Since the neutron beam from horizontal channel of the reactor was chopped by the rotor, the neutron pulses used for measurements consisted of neutrons of near thermal energy. The measurements have been carried out for rectangular geometry and the asymptotic decay constant as a function of buckling has been obtained. Author

N65-30521# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.

POSSIBLE G-PARITY NONCONSERVATION IN MUON CAPTURE REACTIONS—ANGULAR DISTRIBUTION OF RECOILS

Masato Morita, Reiko Morita, and Takeshi Shirafugi (Dept. of Physics) May 1965 18 p refs Submitted for Publication

(RIFP-45)

Induced effects in muon capture reactions are investigated under the assumption of possible G-parity nonconservation. An explicit formula of the angular distribution of the recoils in muon capture is given for unique n-th forbidden transitions (spin change $0 \rightarrow J$, $J = n + 1$; parity change $(-)^{J+1}$). R.N.A.

N65-30522# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.

RANGE OF VALIDITY OF THE ONE-BOSON-EXCHANGE MODEL

Yogiro Hama and Norio Hoshizaki Jun. 1965 12 p refs

(RIFP-46)

The validity of the one-boson-exchange model is discussed in connection with the nucleon–nucleon scattering. From a consideration of the asymptotic behavior of the phase shifts calculated with this model as the incident energy goes to infinity, it is shown that an appropriate limitation in energy must be imposed in order that the theory does not present contradiction with the Levinson theorem. A practical limit of applicability of the model is effectively established in terms of the impact parameter whose critical value is fixed to be $0.4 \sim 0.6\hbar/\mu_\pi c$; for those values of the impact parameter smaller than this, the theory must be cut off. An alternate estimate of the critical value is given in terms of the ranges of the forces due to the exchange of each boson, and shows a reasonable agreement with the former value. A discussion concerning the inclusion of other bosons not yet discovered is also given. Author

N65-30531# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE RANGE OF APPLICATION OF THE CALIBRATION METHOD FOR DETECTING BETA DOSAGE

D. Herrmann and C. F. Weiss 18 May 1965 14 p refs Transl. into ENGLISH from Monatsberichte, Akad. Wiss. (Berlin), v. 5, no. 8, 1963 p 482–489)

(FTD-TT-65-70/1+2; AD-465418)

Standard methods for the calibration of beta dose rate instruments are reviewed, and the errors introduced by various methods are discussed. The extrapolation chamber, thin-walled ionization chamber, films, and luminescent dosimeters are considered. It is recognized that instruments must be calibrated under conditions similar to the conditions under which the instruments are to be used. E.E.B.

N65-30544*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering.

THE CONTROL OF ABSORPTION CROSS-SECTION FOR A NUCLEAR ROCKET

C. N. Shen and T. C. Liu 1 Apr. 1965 33 p refs

(Grant NsG-14-59)

(NASA-CR-64248; AC-3) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The two energy and one delayed neutron group kinetics equations with approximations are employed for the nuclear rocket in this paper. The perturbation equations for kinetics are derived with the assumption that the deviation from the reference flux are small in comparison with the reference values. The temperature effect due to the change of the Fermi Age may be compensated by a feedback loop. The absorption cross-section is changed accordingly so that the system will be made independent of the effect of temperature variation. The spatial distribution of the flux and precursor are assumed to be sinusoidal in the axial direction of the nuclear rocket. The reduced kinetics equations are

obtained from the perturbed equation by introducing exponential weighting function. The index of performance is choosen to be the integral of the square errors on perturbed neutron flux and the control effort. Maximum principle is used to derive the control laws which in turn determines the absorption cross-section, using the measured flux as feedback with a variable gain. The response of the flux and precursor having optimum control under different starting conditions are determined and plotted. Author

N65-30553# Lockheed Missiles and Space Co., Sunnyvale, Calif.
RECOMBINATION OF ELECTRONS WITH NO + IONS IN SHOCK HEATED AIR
R. P. Stein, M. Scheibe, R. C. Gunton, and T. M. Shaw 13 Dec. 1963 61 p refs
(Contract NOw-63-0050)
(Rept.-2-60-63-3; AD-454498)

A measurement of the recombination coefficient in air of density near 10^{-4} gm/cm^3 and temperature near 2900° K gives a value of $(4 \pm 2) \times 10^{-8}$ cm^3/sec. The dissociative recombination reaction $NO^+ + e^- \rightarrow N + O$ is believed to be the dominant depletion process. Air behind a reflected shock at a temperature of 3500° K is expanded suddenly and allowed to pass down a 12-mm-diameter quartz tube. The tube serves as a post in an X-band waveguide. Thus, changes in phase of transmitted signals can be used to obtain the electron density when the system has been calibrated with a plasma of known density. The recombination coefficient is determined from the measured electron depletion coupled with a knowledge of the density, temperature, and velocity of the gas in its unsteady expansion down the quartz tube. The effects of diffusion, impurites, and electron attachment are investigated. Author

N65-30586# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE DECAY SCHEME OF Ne^{23}
H. Lancman, A. Jasinski, J. Kownacki, and J. Ludziejewski Dec. 1964 38 p refs
(Rept.-589/IA/PL)

The decay scheme of Ne^{23} has been investigated. Two new excited states in Ne^{23}/2.405 MeV and 2.87 MeV/ have been found. The spin of the 2.705 MeV state was found to be $\frac{7}{2}$. The level scheme of Na^{23} up to 4 MeV, its ground state magnetic moment, beta and gamma transition probabilities are compared with the predictions of the collective model including the rotation-particle coupling. Using four bands with K = 1/2, 1/2, 3/2 and 5/2 relative good agreement is obtained for $\eta = 4$; $\mu = 0$; $\chi = 0.08$. Author

N65-30603# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
CYCLOTRON INSTABILITY OF ANISOTROPIC PLASMA
V. I. Pistunovich [1963] 43 p refs Transl. into ENGLISH from a Russian Publ.
(AEC-TR-6500)

Electric and magnetic field measurements of a hydrogen plasma in a cyclotron chamber at 10^{-5} mm Hg pressure were compared with theoretical results to explain the observed instabilities. It was concluded that: (1) cyclotron instability is due to the great plasma anisotropy in the velocity space and depends little on the boundary conditions imposed on the plasma; (2) the cyclotron supports propagation of traveling and standing plasma-density waves with the cyclotron frequency of H_2^+ ions; (3) intense peaks in the spectral distribution of the electromagnetic field due to high-speed H_2^+ and H_1^+ ions moving into a cold plasma are due to the large refractive index of the plasma in the low frequency region; (4) the plasma potential increases corresponding to increase in the injected current, leading to a wider energy distribution of molecular ions, their grouping in blobs, interaction with each other, and scattering of energy; and (5) hot plasma accumulation in magnetic traps leads to cyclotron instability when not controlled. G.G.

N65-30607# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE INITIAL VALUE PROBLEM FOR A SLAB WITH ANISOTROPIC SCATTERING
Janusz Mika Apr. 1965 28 p refs Presented at the Symp. on Pulsed Neutron Res., Karlsruhe (West Germany), 10–14 May 1965
(Rept.-611/IX-A/R)

In the paper there are considered the spectral properties of the Boltzmann operator describing the transport of monoenergetic neutrons with anisotropic scattering in a slab. The Hille-Yosida theorem is applied to obtain the semigroup of operators solving the initial value problem. Author

N65-30625# Naval Civil Engineering Lab., Port Hueneme, Calif.
AN ABSOLUTE MEASUREMENT OF THERMAL NEUTRON ALBEDO FOR SEVERAL MATERIALS
Duane Robert Doty May 1965 27 p refs
(R-377; AD-616613) CFSTI: $2.00

Albedo is a concept which has proved useful in the calculation of the penetration of nuclear weapons radiation through a shelter entranceway. The application of the albedo approach to describe the behavior of neutrons impinging upon various materials is the subject of this report. Values of thermal neutron albedo for lead, iron, paraffin, aluminum, carbon, and high-density concrete were measured, using the nuclear reactor of the University of California at Los Angeles. The results are in reasonable agreement with theoretical calculations. Verification of the angular dependence of neutron scattering was attempted, but with only partial success. Albedo as a function of thickness of the scattering material was measured for paraffin, carbon, and aluminum. The results essentially conform with theory. The possibility of using a simple empirical formula for albedo calculations of thermal-neutron streaming through shelter ducts is apparent. Author

N65-30643# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
AN ANALYTICAL SOLUTION OF MULTI-GROUP REMOVAL-DIFFUSION EQUATIONS, IN PLANE MULTI-LAYERED REACTOR SHIELD SYSTEM [ROZWIAZANIE ANALITYCZNE ROWNAN WIELOGRUPOWEGO PRZYBLIZENIA USUNIECIA-DYFUZJI, DLA PLASKIEGO WIELOWARSTWOWEGO UKLADU OSLON REAKTOROWYCH]
L. Szymendera Dec. 1964 45 p refs Submitted for Publication
(Rept.-586/IX/R)

This paper gives the analytical solution of the set of differential equations describing, in the multigroup removal-diffusion approximation of Boltzman transport equation, the neutron flux distributions in the multilayered plane shield of a nuclear reactor. The solution is obtained in closed form of a linear combination of some well-defined auxiliary expression, which can be easily integrated and differentiated. Author

N65-30644# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
EVAPORATION OF NEUTRONS FROM STRONGLY EXCITED CLOSED SHELL $f_{7/2}$ NUCLEI IN ELASTIC NEUTRON SCATTERING

Jozef Koralewski, Tadeusz Kozlowski, Zbigniew Moroz, and Jolanta Wojtkowska Dec. 1964 28 p refs
(Rept.-591/IA/PL)

Continuous spectra of neutrons inelastically scattered on V^{51}, Cr^{52}, and Ni^{58} have been measured with time-of-flight spectrometer at an incident energy of 14.1 MeV. The spectra were observed above the maximum energy of neutrons from the /n,2n/ reaction. From these spectra, the level density parameters T and a have been calculated. The results of investigations and comparisons with other measurements are as follows: /a/ the dominant reaction mechanism in the measured energy range in the evaporation of neutrons, /b/ the Fermi gas model gives a good approximation for nuclei with closed shell, /c/ there is evidence that the effect of pairing is insignificant at the studied excitation energy, /d/ the optical model reaction cross section seems to be a good expression for the inverse reaction cross section. Author

N65-30649# Princeton Univ., N. J. Plasma Physics Lab.
RADIOLOGICAL SAFETY MEASUREMENTS OF X RAYS AND NEUTRONS FROM PULSED SOURCES
H. L. Miller Jul. 1965 30 p refs
(Contract AT(30-1)-1238)
(MATT-347)

Monitors have been developed for continuous, unattended recording of radiation dose at rates ranging from steady state near natural background to extremely high intensity at low duty cycle. The gamma and X-ray monitors have been built in two forms, one as a self-contained unit with its own recorder and the other as remote area monitor system that takes information from a number of remote locations and feeds it into a central multipoint recorder. The gamma and X-ray monitors were designed to operate with X-ray pulses as intense as 8,000,000 mrem/hr for 100 μsec, or proportionately longer at lower intensity. The neutron monitor has been built as a remote unit, interchangeable in the system with the X-ray monitors. It is based on the Bonner Sphere, but the maximum counting rate limitations characteristic of other versions of this instrument have been improved by a factor of 10 by use of delay line shaping to shorten the photomultiplier output pulse to 0.3 μsec. A 0.3 μsec pulse results in a 10% coincidence loss at 267,000 mrem/hr. Author

N65-30652# Oak Ridge National Lab., Tenn. Atomic and Molecular Processes Information Center.
BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES FOR 1963
E. W. Mc Daniel, (Georgia Inst. of Tech.) C. F. Barnett, J. A. Ray, and J. C. Thompson comp. Jul. 1965 32 p refs
(Contract W-7405-ENG-26)
(ORNL-AMPIC-1)

An annotated bibliography is presented on atomic and molecular processes. References are included on heavy particle-heavy particle interactions, interactions of electric and magnetic fields, particle penetration in matter, surface interactions and phenomena, electron-heavy particle interactions, properties of atomic and molecular systems transport phenomena in gases, photon-heavy particle interactions, general theory, experimental techniques and considerations, data compilations, positronium and muonium, reviews and books in the field of atomic and molecular collisions, and bibliographies on atomic collisions. R.N.A.

N65-30671# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A BETA-RAY SPECTROMETER FOR CONVERSION ELECTRON STUDIES
Charles D. David, Jr. (M.S. Thesis) Feb. 1965 68 p refs
(GSP/PHYS-65-7; AD-616691)

A double-focusing, magnetic beta-ray spectrometer was assembled, calibrated, and used to find conversion electrons in light ($Z < 20$) nuclei. A 2 MeV Van de Graaf accelerator was connected to the spectrometer via drift tubes. Various beam handling and monitoring devices were designed and constructed; included were a magnetic quadrupole focusing lens, beam deflecting magnets, target chamber, and Faraday Cup. The spectrometer's field was measured with a rotating coil magnetometer, and a solid state detection system was used. The spectrometer was calibrated with Cs^{137} and Bi^{207} sources and was found to be linear to within 6 parts in 10^4; the resolution of the 624 keV transition in Ba^{137} was 0.24%. A water cooled, CaF_2 target was bombarded with 873 keV protons, and conversion electrons corresponding to the transition from the second excited state to ground state in F^{19} were measured. The second excited state in F^{19} was found to be 198.6 ±0.4 keV above the ground state. Author

N65-30680# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A STUDY OF THE ENERGY SPECTRUM OF ALPHA PARTICLES FROM THE Tb^{159}/n, α/Eu^{156} REACTION WITH 14.2 MeV NEUTRONS
M. Jaskola, W. Osakiewicz, J. Turkiewicz, and Z. Wilhelmi Jan. 1965 13 p refs
(Rept.-596/PL)

The energy spectrum of α-particles from Tb^{159}/n, α/Eu^{156} reaction at 1.42 MeV has been studied using semiconductor detector technique. The characteristic feature of the observed energy spectrum is the existence of four separate maxima in the energy region 15–21 MeV. The positions of these maxima are explained assuming that there exists a large contribution of the knock-out process in the mechanism of the investigated reaction. Author

N65-30698*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DETERMINATION OF ABSOLUTE PHOTON FLUXES AND APPLICATIONS TO LABORATORY CALIBRATION PROCEDURES IN THE 100A TO 300A RANGE
D. H. Tomboulian (Cornell Univ.) Washington, NASA, Aug. 1965 12 p refs
(NASA-TN-D-2917) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The problems and methods of making absolute measurements of the intensity of photon fluxes in the wavelength region from 100 to 300 angstroms are discussed. It is shown that a modified Geiger-Mueller counter can provide a solution to this problem. The actual application of such a Geiger-Mueller counter to the determination of the absolute photosensitivity of a specially developed open-window photomultiplier tube and of two different photographic emulsions is described. The experimental photosensitivities determined by these calibrations are also given. Author

N65-30722*# Southwest Center for Advanced Studies, Dallas, Tex.
MIE SCATTERING AND ABSORPTION CROSS SECTIONS FOR ABSORBING PARTICLES
Gilbert N. Plass [1965] 33 p refs Submitted for Publication
(Grant NsG-269-62; Contract AF 19(628)-5039)
(NASA-CR-64086; AD-616343) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The Mie scattering and absorption cross sections for spherical particles are calculated as a function of the complex index of refraction, $n = n_1 - in_2$. Curves of the efficiency factors

for absorption, scattering, and extinction are given for $n_1 = 1.01, 1.33, 1.5, 2$ and for $n_2 = 10^{-4}, 10^{-2}, 10^{-1}, 1$, and 10. The influence of the absorption on the efficiency factors is discussed. The results are compared with previously proposed simplified expressions for these factors. The variation of the scattered intensity with angle as n_2 is varied is illustrated in some typical cases. Finally the influence of n_2 on the narrow resonances which occur for large values of n_1 is discussed. Author

N65-30765# Brandeis Univ., Waltham, Mass. Astrophysics Inst.
NEUTRINO PAIR EMISSION FROM EXCITED NUCLEI (II) Scientific Report No. 2
Minoru Nishida Feb. 1965 6 p refs Submitted for Publication
(Contract AF 19(628)-4019)
(AFCRL-65-263; AD-616474)

The neutrino emission rate from the excited state of Na^{23} is computed. This neutrino emission is comparable with the other neutrino processes in the density range of 10^5 to 10^6 g/cm^3 and at temperatures near $10^{9°}$ K. Author

N65-30783# General Dynamics Corp., San Diego, Calif. General Atomic Div.
MEASUREMENT OF FAST NEUTRON SPECTRA IN AN INFINITE MEDIUM OF CH_2 Final Report, 24 Mar.–24 Nov. 1964
A. E. Profio and J. Kirkbride Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1965 152 p refs
Contract AF 29(601)-6376)
(GA-5973; WL-TR-64-180; AD-616518)

Measurements of the fast neutron spectrum and angular distribution in a large assembly of paraffin wax (CH_2) were performed for the Air Force Weapons Laboratory. Two targets were irradiated with a pulsed electron beam from a Linear Accelerator, one an essentially point isotropic fission spectrum source and the other a narrow photoneutron source for small angle measurements. The time-of-flight technique was employed to measure the energy from approximately 0.3 Mev. to approximately 15 Mev with an energy resolution of 10 percent. Estimated error in the spectrum is ±10 percent from 0.5 to 8 Mev and ±20 percent outside this range. The source spectra were measured in air for input to calculations. Data were obtained at 0° up to 15 cm penetration with preliminary results to 45 cm. Angular flux measurements were made up to 60° at 30 cm, with preliminary data at 8° and 45 cm. The results, within the stated accuracy and resolution, should be suitable for testing analytical techniques and corresponding shielding codes. Author

N65-30834*# Lockheed Nuclear Products, Marietta, Ga.
COMPUTER PROGRAMS FOR SHIELDING PROBLEMS IN MANNED SPACE VEHICLES
C. W. Hill, C. C. Douglass, Jr., W. B. Ritchie, and K. M. Simpson, Jr. Jan. 1964 137 p refs
(Contract NAS8-5180)
(NASA-CR-64339; ER-6643) CFSTI: HC $4.00/MF $1.00

This report describes effort to extend and refine certain space radiation shielding codes and to provide detailed code descriptions and operating instructions so that the codes may be used at other installations. The approximations in the proton penetration code have been examined and improved where possible. Changes include better attenuation kernel for evaporation neutrons, parabolic rather than linear interpolation in tables, arbitrary angle of incidence for monodirectional proton beams, removal of the assumption of constant cross section within a layer, and inclusion of a source term calculation for secondary gamma rays. Three new codes were written. Program LIGHT computes gamma ray cascades from excited nuclei. Program MSGAM computes gamma ray dose due to the distributed sources developed in the proton penetration code. Program LRSPC computes improved proton range and stopping power data for use in the proton penetration code. The production of cascade gamma rays arising from inelastic nucleon collisions with shield nuclei was examined. Results presented tend to agree with those of Alsmiller et al. A discussion of the discrepancies and their possible origin is given. Author

N65-30879# Oxford Univ. (England). Dept. of Nuclear Physics.
COSMIC RAY EFFECTS FROM ASSAY OF HELIUM ISOTOPES Final Report
K. I. Mayne Jan. 1965 105 p refs
(Contract AF 061(052)-596)
(AFCRL-65-329; AD-617063)

Detailed quantitative measurements of the physical effects which determine the quantity of gas in cosmic ray irradiated materials are reported. First, the cross section for spallation production of rare gas isotopes as a function both of energy and of atomic target number were measured down to 50 MeV. Secondly, diffusion of the rare gases in metal lattices, particularly at low concentrations, was examined by mass spectrometry. Third, the range and straggling of charged particles in various target materials was studied with emphasis on the intermediate energy range. A description of a high-sensitivity mass spectrometer able to analyze samples of 10^7 atoms total is also presented. G.G.

N65-30904# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
NEUTRON SPECTRA IN BULK MEDIA BY TIME-OF-FLIGHT
J. L. Russell, Jr., J. R. Beyster, J. R. Brown, K. L. Crosbie, G. K. Houghton et al 9 Apr. 1965 15 p refs Presented at the IAEA Symp. on Pulsed Neutron Res., Karlsruhe, W. Germany, May 1965
(Contract AT(04-3)-167)
(GA-6313)

The neutron sources used for these measurements were (γ, n) targets of uranium or lead bombarded with a 30 MeV beam from an electron linear accelerator. The linear accelerator beam conditions ranged from about 0.001 to 2 amperes beam current, 20 to 50 nanoseconds pulse width, and 360 pulses per sec. The neutron source strength ranged from about 10^6 to 10^{10} neutrons per pulse. Data are discussed for measurements in paraffin wax, liquid hydrogen, and a combination of lead and graphite. Also, the specific experimental data are compared with the results of calculations using specific computer codes. E.E.B.

N65-30908# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
MEASUREMENTS AND CALCULATIONS OF THE SLOWING DOWN AND MIGRATION TIME
A. E. Profio, J. U. Koppel, and A. Adamantiades 5 Apr. 1965 13 p refs Presented at the IAEA Symp. on Pulsed Neutron Res., Karlsruhe, W. Germany, May 1965
(Contract AT(04-3)-167)
(GA-6290)

Calculations of neutron slowing down and spatial migration are reviewed and extended, experimental techniques are discussed, and the theoretical and experimental results are compared. The discussion is concerned primarily with free-atom scattering without upscattering or multiplication, although examples are given of applications to thermal multiplying media. The space-dependent and space-independent theories

are considered. It is concluded that theoretical methods are available to calculate both spatially-independent and spatially-dependent fluxes as a function of time. In many cases the time-moments are needed which can be obtained from repeated application of any code developed for steady-state problems. More calculations are needed to investigate the effect of absorption and inelastic scattering on the time behavior and moderation efficiency. Satisfactory agreement is obtained between theory and experiment at low epithermal energies in hydrogenous moderators with the resonance capture gamma counting technique. However, more accurate measurements should be made and the spatial dependence should be investigated. E.E.B.

N65-30924# Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France).
SOME SIMPLE SUM RULES IN POTENTIAL SCATTERING
K. Chadan Jul. 1965 18 p refs
(TH-104)

Some Sum Rules are derived for the non relativistic scattering of particles in a given angular momentum state by a central potential of finite radius. They relate the derivative of the phase-shift to the integral, over the whole energy range, of a simple expression of the phase-shift. If bound states are present, they contribute to the r.h.s. by simple expressions. These sum rules are such that, by integrating over a finite energy range in the r.h.s., one gets automatically inequalities, which are, in some respect, similar to those of Wigner, and may have similar applications in low energy scattering of elementary particles. For instance, if one knows the phase-shift, and the energy of the possible bound states, one can calculate easily the radius of the interaction. Author

N65-30945# Los Alamos Scientific Lab., N. Mex.
AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. VII: INTERATOMIC DISTANCE AND ANGLE CALCULATIONS.
A. C. Larson, R. B. Roof, Jr., and D. T. Cromer 28 Jul. 1965 43 p
(Contract W-7405-ENG-36)
(LA-3309) CFSTI: $2.00

The procedures employed and the computer program used for determining the distances between atoms in a unit cell are described. Any three atoms may be characterized by two vectors, each with an end common to one of the three atoms. The program may also be used to determine the angle between these two vectors. Author

N65-30976# Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France).
BARYON-ANTIBARYON PAIR PRODUCTION IN SU_6 SYMMETRY
S. Badier and C. Bouchiat Jul. 1965 13 p refs
(TH-105)

Predictions of SU_6 symmetry with states having orbital momentum $L \neq 0$ were studied by the cross sections for baryon–antibaryon pair production in proton–antiproton collisions. The reaction

$$p + \bar{p} \rightarrow Q + \bar{Q}$$

where Q belongs to the $1/2^+$ baryon octet or to the $3/2^+$ baryon decuplet was used to determine the cross sections for the production of the octet baryon–antibaryon pairs from which all the values for the decuplet pairs can be predicted. A rough agreement between the predictions of SU_6 symmetry and existing experimental results for the production of the baryon–antibaryon pairs belonging to representations 56 and $\overline{56}$ of SU_6 was found. G.G.

N65-31000# California Univ., Livermore. Lawrence Radiation Lab.
FORMATION OF EXCITED HYDROGEN ATOMS FOR NEUTRAL INJECTION
John R. Hiskes 14 Jun. 1965 14 p refs
(Contract W-7405-ENG-48)
(UCRL-12448) CFSTI: $1.00

The dependence of the population distributions of excited hydrogen atoms in a neutral injection beam is discussed as a function of the neutralizer parameters. Expressions for the charge exchange capture cross sections for captures into the excited states through the $n = 15$ level for collisions with hydrogen-like neutralizers were used to calculate the fraction of the total neutral beam captured into the excited levels for incident proton energies in the range from 10 keV to 140 keV in thin targets. It was found that the largest capture ratios are obtained in the lower end of the energy scale. For the H(1s) neutralizer and for energies below 80 keV, captures into p states predominate, followed by s-state and d-state captures. As the principal quantum number of the neutralizer increases, captures into higher angular states dominate at the lower energies. G.G.

N65-31003# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
RADIATION PROPERTIES OF CALIFORNIUM-252
Dean H. Stoddard Jun. 1965 14 p refs
(Contract AT(07-2)-1)
(DP-986) CFSTI: $1.00

The radiation properties of californium (~72 wt % ^{252}Cf) produced by thermal neutron bombardment of transplutonium isotopes are presented. The gamma and neutron radiations associated with this material were converted to dose rate, for evaluation by isotope users. Author

N65-31007 European Organization for Nuclear Research, Geneva (Switzerland).
ANNUAL REPORT NO. 10, 1964
[1965] 174 p refs

Some important scientific results conducted in nuclear research are presented. The existence of two kinds of neutrinos was confirmed. It was shown that the muon and the electron are coupled to their specific kind of neutrino in all processes. The spatial distribution of the weak interaction force within the nucleon was measured and was found to be the same as the electric charge distribution inside the proton, for the vector and the axial-vector interactions. The beta decay of the Λ was studied with bubble chambers and counter methods. This showed the radioactivity of strange particles and that the interaction law was similar to the one for ordinary particles. Other topics under study are: nuclear physics, track chambers, data handling, nuclear physics apparatus, and accelerator research. R.W.H.

N65-31012*# Union Carbide Research Inst., Terrytown, N. Y.
THEORETICAL CALCULATIONS OF THE BREMSSTRAHLUNG CROSS SECTION Progress Report, 15 Jan.–14 May 1965
Clayton D. Zerby [1965] 25 p refs
(Contract NASw-906)
(NASA-CR-64358; UCRI-65-113) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The derivation of the bremsstrahlung cross section is summarized and recorded along with the latest form of the

equations coded in the computer program. The derivation starts in Section II with the presentation of the eigenfunctions of the energy and angular momentum operator of the Dirac equation. These eigenfunctions are used in the matrix element for the production of bremsstrahlung as described in Section III. The final derivation of the cross section is given in Section IV. Of interest in the calculation of the differential bremsstrahlung cross section is the end-point value of the photon energy spectrum where all the kinetic energy is given to the photon. The recent derivation of this value is included in Section V as a limiting value of the case of the pure Coulomb field. R.N.A.

N65-31030# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.
SIMULATED BRILLOUIN SCATTERING IN ANISOTROPIC MEDIA AND OBSERVATION OF PHONONS
H. Hsu and W. Kavage 15 Jun. 1965 17 p refs
(Contract AF 33(615)-2287)
(Rept.-1935-4; AD-466176)

Stimulated Brillouin scattering belongs to the general class of parametric interactions of waves and quasi-particles such as magnons, and plasmons as well as phonons. These interactions are governed by Tien's phase matching equations corresponding to the conservation relationships of energy and momentum. For anisotropic media, the interaction can be classified into three types depending upon the scattering angle between the incident and scattered light. In this paper, the basic process of stimulated Brillouin scattering in anisotropic media is discussed. It is shown that stimulated phonons at radio frequencies can be excited and propagated at room temperature. The characteristic of these phonons in crystal quartz is discussed. The result of the investigation indicates that there is a tendency for stimulated Brillouin scatterings to be initiated near the boundaries of finite crystals due to the relatively large phonon anharmonicity at the boundary. The phonon anharmonicity appears to be the dominating factor in the nonlinearity responsible for parametric interaction in stimulated Brillouin scattering. Author

N65-31035*# RAND Corp., Santa Monica, Calif.
ESTIMATION OF INTERNAL SOURCE DISTRIBUTIONS USING EXTERNAL FIELD MEASUREMENTS IN RADIATIVE TRANSFER
R. E. Bellman, H. H. Kagiwada, and R. E. Kalaba Jun. 1965 17 p refs
(Contract NASr-21)
(NASA-CR-64361; RM-4837-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The intensity of the emergent radiation is determined for a finite homogeneous slab which absorbs radiation and scatters it isotropically. Invariant imbedding techniques are used and the distribution of the internal sources that best accounts for an observed emergent radiation pattern is determined. This inverse problem is treated as a nonlinear two point boundary value problem and is resolved numerically using quasilinearization. R.N.A.

N65-31052*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
PHYSICS OF PLANETARY ATMOSPHERES. 1: RAYLEIGH SCATTERING BY HELIUM
Y. N. Chan (Queen's Univ., Belfast) and A. Dalgarno Apr. 1965 11 p refs
(Contract NASw-1283)
(NASA-CR-64187; GCA-TR-65-14-N) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A variational method is used to calculate the Rayleigh scattering cross sections of helium as a function of wavelength. The value at Lyman-α is 3.53×10^{-26} cm^2. Author

N65-31141*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
VIBRATIONAL ENERGY TRANSFER IN HIGH ENERGY COLLISIONS
Charles E. Treanor Washington, NASA, Aug. 1965 22 p refs
(Contract NASr-119)
(NASA-CR-291) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Time-dependent wave functions are used to evaluate the exact transition probabilities for a forced harmonic oscillator. The forcing is represented by a time-dependent potential, where this potential has a linear dependence on the oscillator coordinate. The results are compared with available numerical solutions for a harmonic oscillator forced with a potential which has an exponential dependence on the oscillator coordinate. The comparison is made for the collision of an N_2 molecule with another particle, and it is found that although the results for the two cases are similar, the linear potential gives higher values for the multiquantum transitions. It is then shown that time dependent wave functions which contain the corresponding classical motion as a parameter provide a good set of functions for a perturbation calculation. The energy transfer to these oscillating wave functions is always identical to the energy transfer to the classical oscillator. Thus the perturbation value of the energy transfer represents the difference between the classical and the quantum mechanical result. It is shown that this value, which is zero for the linear forcing potential, is very small for higher order potentials, even at high velocity of impact. Author

N65-31161# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
TWO-CHANNEL GENERATION OF THE ρ BY ONE- AND TWO-PARTICLE EXCHANGE FORCES
Jean-Loup Gervais Jun. 1965 27 p refs
(TH/102)

Calculations are presented for solving the two-channel problem for the ρ parameter generated by one-particle exchange (OPE) forces; and for the bootstrap problem, using similar methods but including two-particle exchange (TPE) forces. The OPE and TPE forces considered are described. Only $\pi\pi$ and $K\pi$ exchange forces are taken into account among the TPE contributions. In the bootstrap problem, it is shown that the model leads to self-consistent solutions for the ρ problem in the two-channel $\pi\pi$, $K\bar{K}$ approximation. The results for the two methods are compared, and the method of handling the TPE forces improved the numerical results. The dependence of the results on the substraction point of the N/D method was also studied, and it was shown that contrary to the OPE results, the solutions only weakly depend on this parameter. Thus the TPE approximation appears to be reliable. In addition, the main results of the ρ problem are presented and compared with the results of the K* (parameter) problem. L.S.

N65-31166# European Atomic Energy Community, Brussels (Belgium).
CODE FIRST I—IBM 7090 FORTRAN II CODE FOR THE CALCULATION OF A NEUTRON SPECTRUM FOR A HETEROGENEOUS LATTICE
H. Takahashi and H. De Wolde 1965 25 p refs
(EUR-2294.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The code FIRST performs the calculation of thermal neutron spectra in a cylindrical cell system by using the first flight collision probability method. The system is composed of regions, for example, fuel, moderator and coolant. The

regions are divided into subregions and the first flight collision probabilities (F.F.C.P.) in these subregions are calculated for each energy group. The simultaneous equation for the fluxes in subregions is solved by the iteration method. Author

N65-31204# Queens Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics.
THE STOPPING POWERS OF ATOMS AND MOLECULES
Y. M. Chan and A. Dalgarno [1964] 11 p refs
(Contract AF 61(052)-780)
(AFCRL-65-267; AD-618139)

A procedure is described for calculating the average excitation energy of an atom or molecule appropriate to the slowing down of a beam of charged particles in a gas. The procedure is applied to helium with the result that its average excitation energy is 42.0 eV. Author

N65-31227# Naval Civil Engineering Lab., Port Hueneme, Calif.
MONTE CARLO CALCULATION OF NEUTRON STREAMING THROUGH TWO-LEGGED-DUCT ENTRANCEWAYS
Leonard B. Gardner and Alan J. Mettler Jun. 1965 90 p
(R-379; AD-616521)

Several techniques for calculating dose rates in the study of shelter entranceways are reported herein. Calculations have been verified by experiments. These calculations also determine neutron energy spectra, a parameter that is difficult to measure and which is very useful in gaining insight into the design of protective structures. Both the neutron flux spectra and dose rates are calculated for various positions along the centerline of a two-legged duct. Calculations were performed utilizing the ADONIS computer code which solves the Neumann approximation to the transport equation by Monte Carlo techniques. These Monte Carlo calculations were compared to second-leg calculations utilizing a semiempirical albedo formula, and were also compared to experimental measurements made with a tissue equivalent dosimeter. Included is a discussion of UNIGEOM, a generalized computer program for ADONIS geometry, designed to be run on the IBM 7094. Author

N65-31239# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
QUASI LOCAL ELECTRODYNAMICS
Maurice Priou Jun. 1965 40 p refs
(TH-101)

A quantum electrodynamic theory is presented which includes space-like paths, and which is developed from a Lagrangian that explicitly contains a bare photon mass and is fully gage invariant. This theory is neither local nor covariant, but is closely related to the usual electrodynamics: it is possible to construct an interaction representation, express the S-matrix in Dyson form and use Feynman rules for computation, as is done in local electrodynamics. Gage invariance is secured in every step of the computations, and local electrodynamics results when one of the Lagrangian parameters approaches zero. J.M.D.

N65-31243# California Univ., Berkeley. Lawrence Radiation Lab.
PHYSICS DIVISION SEMIANNUAL REPORT, NOVEMBER 1964–APRIL 1965
10 May 1965 70 p refs
(Contract W-7405-ENG-48)
(UCRL-16099)

Areas of research covered during the report period include: (1) the K-72, K-63, and π-63 experiments in the 72-inch bubble chamber; (2) construction of a beam to be used with the 25-inch bubble chamber and capable of transmitting K^- mesons at 435 MeV/c; (3) a high energy proton experiment; (4) data reduction operations and development; (5) operation and development of the 25-inch and 72-inch hydrogen bubble chambers; (6) strange-particle, pion, and space research; (7) mathematics and computing services; (8) computer program development and data processing operations; and (9) accelerator operation and development. R.R.D.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-30190# Princeton Univ., N. J. Plasma Physics Lab.
A DISSIPATIVE INSTABILITY IN MIRROR CONTAINMENT SYSTEMS
John M. Greene and Bruno Coppi Aug. 1965 9 p refs
(Contract AT(30-1)-1238)
(MATT-355)

A relatively slow instability, caused by dissipation in a mirror type plasma containment device that is supposedly stabilized by finite gyration radius effects, is described. In a plasma so stabilized the energy of the stable oscillation is negative; a general equation is given for this negative energy oscillation. Viscosity is also a primary source of dissipation of flute modes in a mirror containment device since flute oscillation is a shear flow. As this causes instability in systems of this type, equations are given for treating this problem. C.T.C.

N65-30401 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF VOLT-AMPERE CHARACTERISTICS OF THERMIONIC CONVERTER IN DIFFUSION CONDITIONS
V. P. Karmazin and I. P. Stakhanov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 1–13 refs (See N65-30400 19-23)

A theoretical analysis of volt-ampere characteristics of a thermionic converter under conditions of diffusion is reported. Analyzed was a flat thermionic energy converter filled with cesium, where the length of the free path of electrons is less than the distance between the electrodes, and degree of ionization is assumed so minute that electron scattering and ions occurs basically on atoms of cesium. Presented are calculations for boundary conditions under which significant deviations from thermodynamic equilibrium occur on the cathode, and methods for the numerical solution of diffusion equations in three-component mixtures. S.C.W.

N65-30402 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSFER EQUATIONS FOR NONISOTHERMISTIC MULTITYPE PLASMA
M. Ya. Aliyevskiy and V. M. Zhdanov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 14–23 refs (See N65-30400 19-23)

In present work a system of transport equations following from kinetic equation for particles of α-type leads to closed form by use of approximation of Grad's "13-moments". Besides usual equations of continuity, conservation of momentum and energy conservation for each of the components of plasma, the obtained system contains equations for nondiagonal part of stress tensor and heat flow of particles. Temperatures of

components are considered different. Relationships for known properties of transfer in plasma follow from general transport equations on the assumption that parameters of plasma change little on mean free paths and for times of the order of time of collisions. It is shown, in particular, that expressions for tensor of viscosity of heat flow and of conductance current in two temperature partially ionized gas ($T_e \geq T_i = T_a$) have, with certain limitations, the same form as if series of quantities entering into them is determined at electronic temperature T_e.
Author

N65-30403 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THEORY OF WEAK DIFFUSION WAVES
G. S. Leonov and V. A. Pogosyan *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 24–32 refs (See N65-30400 19-23)

In the solution of system hydrodynamic and electrodynamic equations for electron and ionic gases during absence of external magnetic field, it was shown that in cylindrical symmetric discharge two types of traveling waves along the axis of a discharge pipe can exist; electronic and ionic. It was also shown that electron waves fade quickly, and that ion waves can fade as well as be strengthened. At present it is clear that striae (layers) do not have direct relation to longitudinal electric oscillations of electrons and ions in a plasma. In these investigations is applied the method of small perturbations. Resultant dispersion relationships are suitable for description of only moving or only standing striae. On the basis of experimental data a conclusion is made about the unique nature of striae. A system of equations in which thermal diffusion and dependence of parameters of equations on electron temperature is considered. Obtained dispersion relationship is useful for description both of mobile and motionless striae. It can be extended also to the case of a positive column in a longitudinal magnetic field.
Author

N65-30404 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHANGE OF ELECTRIC POTENTIAL NEAR WALL OF CHANNEL DURING MOTION OF IONIZED GAS IN MAGNETIC FIELD
G. A. Lyubimov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 33–51 refs (See N65-30400 19-23)

An analysis of changes in the distribution of electric potentials near the conducting walls of a channel through which gas moves in the presence of a magnetic field is reported. Investigated were changes in viscous boundary layers (electroconductive liquids), layers adjacent to electrodes, gas-wall contact potentials in the absence of current, and layers adjacent to electrodes in the presence of current. Also analyzed were varying conditions under which electrons are emitted, and several types of electron emission. Included are formulas from which volt-ampere characteristics were calculated. S.C.W.

N65-30423 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF AVERAGE SECTION OF COLLISIONS OF ELECTRONS WITH NEUTRAL ATOMS OF WEAKLY-IONIZED GAS MIXTURE
E. P. Zimin and V. A. Popov *In its* J. of Appl. Mech. and Tech., Phys. 8 Feb. 1965 p 235–238 refs (See N65-30400 19-23)

Experiments are described for the determination of the collision cross sections for electrons with neutral atoms at temperatures of 1900° to 2300° K. The combustion products were methane–air and methane–oxygen mixtures with temperature modification by mixture composition variation. Slightly ionized admixtures were introduced into the oxidizer flow just prior to the preliminary mixing chamber in the form of aqueous solution of K_2CO_3. Results are given for three values of concentration of K_2CO_3. The error of the determinations did not exceed 3 to 5%.
E.E.B.

N65-30424 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW BETWEEN PARALLEL WALLS IN PERIODIC MAGNETIC FIELD
I. B. Chekmarev *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 239–241 refs (See N65-30400 19-23)

The stationary flow of viscous electrical conducting liquid between parallel plates is considered. The differential equations are derived for the pressure distribution, and velocity profiles are given as a function of the longitudinal coordinate. The significance of these profiles is discussed, and equations are presented for determining the velocity distribution within the flow field.
E.E.B.

N65-30425 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT MODELING OF MAGNETOHYDRODYNAMIC FLOW IN CHANNEL IN ELECTROLYTIC BATH
V. V. Nazarenko *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 242–246 refs (See N65-30400 19-23)

The properties and parameters of magnetohydrodynamic flow in a flat channel in an electrolytic bath are discussed. Equations are given for the determination of these parameters, and the significance of these parameters is presented. The velocity of the liquid is determined from hydrodynamic equations, and the distribution of the current density and electrical potential in the channel is found from Ohm's law and the inseparability equation.
E.E.B.

N65-30492# Massachusetts Inst. of Tech., Cambridge.
APPROXIMATE SOLUTIONS FOR SKIN FRICTION AND HEAT TRANSFER IN MHD CHANNEL FLOWS
W. Craig Moffatt Jun. 1965 33 p refs Presented at Asme-aiche Heat Transfer Conf. and Exhibit, Los Angeles, 8–11 Aug. 1965
(Contract Nonr-3623(00); Proj. Squid)
(MIT-36-P; AD-465580)

This paper presents the results of a theoretical analysis of viscous and thermal boundary layer behavior on the electrically insulating wall of a rectangular MHD channel, using momentum and energy integral approximations. Steady, two-dimensional, constant-property, low magnetic Reynolds number flow is assumed with magnetic and electric fields imposed parallel to the short and long channel side-walls respectively. Analytical and numerical solutions are obtained for laminar skin friction and heat flux, and for turbulent skin friction, as a function of distance from the channel entrance. These results are compared with those for the case of no applied fields and possible reasons for the differences are set forth.
Author

N65-30551# Massachusetts Inst. of Tech., Cambridge.
THE VALIDITY OF INTEGRAL METHODS IN MHD BOUNDARY LAYER ANALYSES
John B. Heywood and W. Craig Moffatt Jun. 1965 16 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(MIT-37-P; AD-465570)

Consideration is given to the minimum conditions which must be satisfied in order that approximate solutions of boundary layer problems using integral techniques are acceptable for MHD applications. The criteria used for solution acceptability

are those proposed by Schlichting together with the requirement that errors resulting from the approximations should be small compared with the differences between the behavior of an MHD flow and its ordinary hydrodynamic equivalent flow. Specific problems considered are the laminar momentum boundary layer, the turbulent momentum boundary layer, and the laminar thermal boundary layer. For the laminar momentum boundary layer, acceptable integral solutions exist. For a limited range of Hartmann and Reynolds numbers, the fully developed solutions for the turbulent boundary layer are satisfactory, and the results in the developed region may be accepted tentatively. However, for the laminar thermal layer, no satisfactory solution exists. Experimental data for the developing MHD boundary layers are suggested as the best test of integral method results. Author

N65-30615# Princeton Univ., N. J. Plasma Physics Lab.
PLASMA OSCILLATIONS AT HARMONICS OF THE ION GYROFREQUENCY
N. D'Angelo, S. v. Goeler, and A. Levine Aug. 1965 7 p refs
(Contract AT(30-1)-1238)
(MATT-353)

Plasma electrostatic oscillations near the ion cyclotron frequency have been found in thermally ionized cesium and potassium plasmas if the electron drift velocity exceeds ≈10 times the ion thermal velocity. A theory of electrostatic waves near the ion gyrofrequency has been developed by Rosenbluth, and is in good agreement with the experiments. Collisional effects have been considered by Varma and Bhadra, who obtained the result that only for $\omega\tau \leq 10$, collisions might play a role in the experiments. Theory predicts also the excitation of oscillations near the harmonics of the ion gyrofrequency. In this note, the experimental observation of oscillations with $\omega \approx m\omega_i$ (m = 1, 2, 3, 4, 5), where ω_i is the ion gyrofrequency is reported. The experimental setup was essentially the same as that in previous works reported, except for the confining magnetic field, which could be raised up to 16 KG. N.E.A.

N65-30627# Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.
TWO-DIMENSIONAL HEATED JET WITH AN ARBITRARY PRANDTL NUMBER AND MAGNETOGASDYNAMIC FREE JET
David C. Smith and Ali Bulent Cambel Oct. 1964 59 p refs
(Grants AF-AFOSR-307-62; AF-AFOSR-329-63)
(NU-GDL-B-2-64; AFOSR-65-0926; AD-616789)

Most of the existing solutions to the free jet problem are restricted by assumptions of constant viscosity, a unitary Prandtl number and incompressible fluids. The solution of the two-dimensional, laminar jet of a compressible fluid with an arbitrary Prandtl number is presented for subsonic flow. A solution is also obtained for any Mach number flow for a Prandtl number of one. The laminar, compressible, two-dimensional jet of an electrically conducting fluid with an applied transverse magnetic field is solved by a perturbation technique. The perturbation parameter is the non-dimensional ratio of the magnetic force to the inertia force of the jet. The velocity profiles are also obtained, to first order, for an electric field applied in a direction normal to both the magnetic field and the axial direction. The solution is valid for an electric field that is the same order of magnitude as the $\bar{v} \times \bar{B}$ force. Author

N65-30727*# California Univ., Berkeley.
MAGNETOHYDRODYNAMIC WAVES IN A PLASMA SLAB
Elisabeth A. Cooper Washington, NASA, Aug. 1965 28 p refs
(Grant NsG-243-62)
(NASA-CR-281) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Magnetohydrodynamic wave propagation in a plasma bounded by a vacuum or a neutral gas was studied in order to improve understanding of the propagation of these waves in the magnetosphere and their characteristics as observed on the surface of the earth. For simplicity a two-dimensional problem, consisting of a magnetized plasma bounded by two planes was considered. It is shown that the waves which may propagate in a bounded plasma must satisfy more stringent conditions than waves in an infinite plasma, and that it may be necessary to use bounded plasma theory in interpretation of magnetohydrodynamic wave observations. E.E.B.

N65-30736*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PRESSURE PROFILE OF A ROCKET PAYLOAD AFTER NOSE-CONE EJECTION
N. Mc Ilwraith and D. L. Lind Washington, NASA, Aug. 1965 15 p ref
(NASA-TN-D-2964) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A measurement was made of the pressure at the instrument rack of a typical sounding rocket. It was found to be more than four orders of magnitude higher than the standard ambient pressure at nose-cone ejection at 687,000 feet. This difference decreased to about 3 orders of magnitude after a few seconds. Ram pressure contributed about one order of magnitude, but the major pressure differential was due to the outgassing of the payload. Ground-based pressure simulation experiments were conducted to determine if an experiment which is susceptible to corona breakdown could be operated without a vacuum pump. It was shown that pressure conditions close to the payload do provide a sufficient differential to evacuate an experimental package if large pump-out ports are provided. Analysis showed that the major portion of the gas load was water vapor associated with a Room Temperature Vulcanizing (RTV) silastic potting compound used in the experiment. Author

N65-30799# Microwave Associates, Inc., Burlington, Mass.
MILLIMETER WAVE COMPONENT DEVELOPMENT (BEAM-PLASMA AMPLIFIER) Final Report, Jan. 1963–Nov. 1964
Paul Chorney and Richard J. Madore Griffiss AFB, N. Y., RADC, Apr. 1965 139 p refs
(Contract AF 30(602)-2948)
(RADC-TR-65-53; AD-616548)

The requirements of plasmas for use in millimeter and sub-millimeter-wave beam plasma amplifiers are discussed. The criteria are described for determining the gas type and pressure in terms of the mean-free path of beam electrons. The theory of electron beam scattering is examined and it is found that electron-atom collisions dominate over electron-ion collisions. Extensive experimental studies of the PIG discharge are described. The parameters affecting the discharge such as pressure, magnetic field, and geometry are examined. A maximum value of magnetic field is found beyond which anomalous diffusion results in a decrease in plasma density. A theory for the double-hot-cathode PIG discharge is described based on ambipolar diffusion in a magnetic field. The theory predicts axial and radial density profiles that are in good agreement with experiments. A 2 mm BPA study vehicle is described. Useful data was obtained on cold signal transmission through the device. The construction and testing of a 2 mm vacuum window is also discussed which shows good electrical and mechanical characteristics. Some waveguide components which were constructed are described. Author

N65-30850# Northrop Space Labs., Hawthorne, Calif.
INVESTIGATION OF THE INTERACTION OF A PREIONIZED GAS WITH AN ELECTRIC ARC Interim Technical Report

H. N. Olsen, C. D. Maldonado, A. P. Caron, and L. R. Dawson
Wright-Patterson AFB, Ohio, ARL, Mar. 1965 71 p refs
(Contract AF 33(615)-1105)
(NSL-64-356; ARL-65-48; AD-616353)

The free-burning dc electric arc and plasma jet operating in argon at atmospheric pressure have been accurately calibrated and compared with independent measurements made in other laboratories. These plasmas have been interacted to provide a general concept of the distorted plasma geometry to be encountered in a future basic research program aimed at the investigation of interacting plasmas in an external magnetic field. Because of the lack of circular symmetry in the interacting system of plasmas, new analytical methods have been developed for converting externally measured integrated spectral line intensities to emission coefficients, a required step in the process of determining plasma temperatures. Theoretical consideration has also been given to the effect of nonequilibrium on measured spectral line emission coefficients and the possibility of experimentally detecting any existing difference between electron and heavy particle temperatures. The effect of this nonequilibrium on gas density and static enthalpy has also been included. Author

N65-30865# Brown Univ., Providence, R. I. Div. of Engineering.
ASYMPTOTIC THEORY OF A PHOTOIONIZATION CHAMBER: I
Ira M. Cohen Apr. 1965 39 p refs
(Contract Nonr-562(35))
(Nonr-562(35)/9; AD-617186)

A photoionization chamber consists of two parallel plates between which a test gas is photoionized. The charged particles thus produced then diffuse to the plates where they recombine. This process is analyzed in detail when the fraction of ionization is very low and the mean free path for charged-neutral encounters is very small compared to the chamber width. Particular attention is paid to the physically important limit of sufficiently large charged particle densities to make the Debye length small compared with any macroscopic dimension. In this limit the plasma is quasineutral in the body of the chamber. Near the walls, however, quasineutrality breaks down and a new scaling of the variables is necessary to account for the changed orders of magnitude of the properties in the sheaths. The sheath equations are reduced to one previously solved by the author (in connection with a spherical electrostatic probe problem). The sheath solution and quasineutral plasma solution are asymptotically matched in their region of common validity. Thus charged particle and electric field distributions are found and typical curves are given. From the tabulated data, current-voltage characteristics of the photoionization chamber may be constructed. Author

N65-30898# France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
A MODEL OF SOME PLASMA SHOCK STRUCTURES
Paul Germain [1964] 51 p refs Presented at Symp. on Magneto-Fluid and Plasma Dyn., New York, 12–15 Apr. 1965 Submitted for Publication
(TP-241(1965))

This work intends to give a general study of one-dimensional steady flows of a two fluid plasma. Charge neutrality and isotropic pressure are assumed; viscosity and heat conduction are neglected. But the electrical conductivity may be taken finite or infinite and the equation of state is subjected only to Weyl's convexity inequalities. A complete classification and description of the solutions is given when there is no longitudinal component of the magnetic field; it covers many special cases which can be found in the literature. Special attention is paid to the comparison between the one-fluid and the two-fluid theories. Some of the results are extended to the more general case when a longitudinal magnetic field is present. Author

N65-30939# Nagoya Univ. (Japan). Inst. of Plasma Physics.
EFFECTS OF A MAGNETIC FIELD ON ELECTRON PROBE CURRENTS
Minoru Sugawara and Yoshisuke Hatta Jun. 1965 11 p refs
(IPPJ-33)

An experimental study is presented of the electron saturation currents arriving at a plane probe situated in a plasma in a magnetic field. Ratios of the electron saturation current collected by a disc-shaped probe parallel and perpendicular to the magnetic field were measured with two probes. Many measurements showed that these ratios decrease slowly with increasing $\psi_e = \omega_e \tau_e$ and that the curves moved to an increasing ψ_e range as the gas pressure was decreased, indicating that electrons were flowing to the probe by diffusion. Ratios of $I_{e\perp}$ and $I_{e\parallel}$ to the electron probe current in no magnetic field (I_{e0}) were also measured. Among these three curves the curve of $I_{e\perp}/I_{e\parallel}$ exhibits the most slow decrease, and the curve of $I_{e\perp}/I_{e0}$ exhibits the sharpest decrease at the same gas pressure; i.e., with increasing magnetic field. It seems clear that the effect of the magnetic field on the electron diffusion is the most important factor, as far as electron collection is assumed to be controlled by the need for the compensation by diffusion of the electrons depleted by the probe. Author

N65-30940# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ENHANCEMENT OF CYCLOTRON HARMONICS IN A HOMOGENEOUS MAGNETOPLASMA
Ryo Sugihara May 1965 14 p refs
(IPPJ-35)

A theoretical investigation is made of the radiation from a point charge e gyrating in a plane perpendicular to a magnetic field. The velocity v of the charge is assumed to be non-relativistic but much larger than the thermal velocity v_T. In $v/v_T \gg 1$. Under the conditions $|\epsilon_1| \gg (sv_T/v)^{4/3s-2}$, $\epsilon_3 \gg (v_T/sv)^2$ and $\omega_0^2 < \omega_r^2 = (s\omega_H)^2 < \omega_0^2 + \omega_H^2$, the intensity of the s-th harmonic is enhanced and given by

$$\frac{2e^2\,\omega_r^2}{\pi sv\sqrt{|\epsilon_1\epsilon_3|}}\ln\frac{v}{v_T}.$$

Here ω_0 and ω_H are the plasma frequency and the electron cyclotron frequency, respectively, s is a positive integer larger than unity and $\epsilon_1 = 1 - \omega_0^2/(\omega_r^2 - \omega_H^2)$, $\epsilon_3 = 1 - \omega_0^2/\epsilon_1^2$. A harmonic structure appears when ω_H or ω_0 is changed. Author

N65-30941# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ELECTRICAL CONDUCTIVITY OF A PLASMA IN "IDEAL" TURBULENCE
Taro Kihara Jun. 1965 10 p refs
(IPPJ-36)

The unified theory of relaxation was employed to analyze the electrical conductivity of a plasma that was in ideal turbulence composed of electrons of one type of ion with no magnetic field. Assumed was a small de Broglie electron wavelength in comparison with the close collision radius, and it was found that an ideal turbulence does not influence the high frequency conductivity of the plasma. The electron-electron interaction in an ideal turbulence enhances the rate of relaxation sufficiently to reach Maxwellian distribution for any value of electron collision frequency. G.G.

N65-30942# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ELECTRON ACCELERATION IN PLASMA WAVE EXCITED BY RESONANCE PROBE
Johsin Uramoto and Kazuo Takayama Jun. 1965 19 p refs
(IPPJ-38)

Another sort of peak, in the dc current component of the resonance probe, is observed when the plane probe is set across a plasma beam (neutralized ion beam) produced by the pack diffusion type mercury discharge. The dc peak is different from the ordinary sheath resonance and appears at a frequency higher than that frequency. A discharge tube for producing the plasma beam contains an electron injection region in the opposite boundary against the plane probe. The dc peak depends on plasma beam density, applied rf signal voltage, length between the resonance probe and the opposite boundary, and pressure. The dc peak is considered to appear at the electron plasma frequency, and to result from the synchronous acceleration of electrons injected into the plasma wave excited one-dimensionally in the plasma beam by the resonance probe.
Author

N65-30959*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF A RADIAL-FLOW HALL CURRENT MAGNETOHYDRODYNAMIC GENERATOR
Lester D. Nichols Washington, NASA, Aug. 1965 17 p refs
(NASA-TN-D-2973) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A magnetohydrodynamic generator of two-disk geometry operating in the Hall mode is considered. The generator working fluid flows radially between the two disks and a constant magnetic field is applied parallel to the axis of the disks. The conditions where the Mach number is small compared to one and where viscous effects can be neglected are analyzed. The power output, power-output density, and efficiency of this generator are determined and compared to the linear Hall generator. The calculations indicate that the linear generator has higher efficiency and power output for a given working fluid and entrance velocity.
Author

N65-30966# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
IONIZATION WAVES IN A LONGITUDINAL MAGNETIC FIELD
William P. Burckel (M.S. Thesis) Feb. 1965 99 p refs
(GS/PH/65-3; AD-616689)

The effects of a longitudinal magnetic field (0 to 850 gauss) on running striations occurring in low pressure (0.1 to 2.0 mm Hg) glow discharges of Helium, Neon and Argon were studied. Also the electron temperature and the charge density profiles of particular striations were determined by Langmuir probe techniques. The variation of the striation parameters of wavelength, velocity and frequency were found to be oscillatory with the magnetic field intensity. The theory which was used to describe striations in a longitudinal magnetic field was found to be inadequate for the experiments. This was probably because the theory neglects end conditions which seemed to dominate in the short discharges studied. Other oscillations were also detected and found to be a result and a function of the magnetic field. The probe measurements showed the light intensity wave of the striation to be in phase with the charge density wave with the electron temperature wave leading by less than 90°
Author

N65-30970# Illinois Univ., Urbana. Coordinated Science Lab.
PLASMA PHYSICS Final Technical Summary Report, Period Ending Sep. 30, 1964
30 Sep. 1964 29 p refs
(Contract DA-28-043-AMC-00073(E); ARPA Order 112)
(AD-616681)

The injection of relatively strong electron beams with large energy spread into a high density plasma gave no indication for an electrostatic instability of the beam. Anomalous energy losses of the beam at the onset of an instability are believed to be the stabilizing mechanism. Disappearance of the excitation light of the beam at a critical electron density was, however, observed. The origin of this effect is not understood at the present time.
Author

N65-31076# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A HIGH-CURRENT IMPULSE ION SOURCE
M. A. Abroyan and V. L. Komarov 20 May 1965 21 p refs
Transl. into ENGLISH from Nauchn. Issled. Inst. Elektrofiz. App. Elektrofiz. App. Sb. Statey (USSR), no. 1, 1963 p 119-133
(FTD-TT-65-449/1+2; AD-617662)

Described is a duoplasmatron impulse hydrogen ion source that incorporates a cover plate-extracting electrode with a grid selection system, and a plasma emission aperture in the region of maximum magnetic field strength. Experiments with this source obtained converging and diverging impulse ion beams with currents up to 1.5 A. A focused ion beam of 170 mA and a minimum diameter of 10 mm was obtained by the application of an immersion lens of larger potential.
G.G.

N65-31083# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
SINGULAR-PERTURBATION METHODS APPLIED TO MAGNETO-GASDYNAMICS AND PLASMA PROBLEMS Final Report, 1 Jun. 1963-31 May 1965
I-Dee Chang 24 Jun. 1965 9 p refs
(Grant DA-ARO(D)-31-124-G457)
(AROD-4284-3; AD-617258)

The magnetic effect in a conducting fluid upon boundary-layer separation over a circular cylinder was studied. In the analysis based on a linear model, the equations were reduced by introducing a modified Reynolds number which characterizes both viscosity and magnetic effects. The dependence of separation point on the modified Reynolds number was studied by finding the solutions of the reduced equations using the method of inner and outer expansions. The existence of equilibrium ranges in homogeneous hydromagnetic turbulence was also analyzed using Fourier technique. It was found that the reasons supporting the existence of the equilibrium range in classical turbulence also hold for hydromagnetic turbulence. The compressible Navier-Stokes equations were treated by a perturbation method for the problem of a slowly moving sphere. The purpose of the investigation was to find some general information which would be useful in the study of suspended systems, both in the case of electric conductive and nonconductive fluids.
E.E.B.

N65-31191# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON A NONLINEAR THEORY OF PLASMA WAVEGUIDE
A. M. Kondratenko 25 May 1965 8 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 8, no. 4, 1963 p 488-490
(FTD-TT-65-142/1; AD-467252)

Questions are discussed which pertain to the expansion of an axially-symmetrical electromagnetic wave in a plasma cylindrical waveguide in approximation to a small nonlinearity.
R.N.A.

N65-31232# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ON THE RETROGRADE MOTION OF A LOW PRESSURE ARC DISCHARGE IN A TRANSVERSE MAGNETIC FIELD
Hugo Weichel (M.S. Thesis) Jun. 1965 184 p refs
(GSP/PH/65-19; AD-616708)

A comprehensive and up-to-date literature survey is presented on the unorthodox motion of a low pressure arc discharge in a transverse magnetic field. As a result of the present experimental and theoretical investigation additional information is presented, and a new hypothesis, based on a combination of the Hall effect, evaporation of the cathode, and the electrode surface condition, is proposed in an effort to explain the retrograde motion of an arc discharge. TAB

N65-31245# Nagoya Univ. (Japan). Inst. of Plasma Physics.
INTERNAL PLASMA RESONANCE OF POSITIVE COLUMN NEAR ELECTRON CYCLOTRON HARMONIC FREQUENCIES
Shigetoshi Tanaka Jun. 1965 37 p refs
(IPPJ-34)

A series of subsidiary resonance peaks observed near the electron cyclotron harmonics is studied by the measurements of microwave radiation from a positive column in a magnetic field. When an external microwave is applied to the plasma column to heat plasma electrons, an intensity of subsidiary resonance peaks increases extremely and also a number of their peaks increases. Further, their dispersion curves displace toward a higher magnetic field and toward a higher electron density, compared with those when there is no heating power. The experimentally observed behavior of these peaks can be explained from the fact that a series of subsidiary resonance peaks is resulted from the internal plasma resonance due to the standing plasma waves within the propagating region of the plasma column. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-30199# Tronetics, Hollywood, Calif.
COLOR DISPLAYS BASED ON MAGNETOCHEMISTRY
Final Technical Report, May 1963–Nov. 1964
A. Dulyanai and Lyne Trimble Griffiss AFB, N. Y., RADC, Mar. 1965 159 p refs
(Contract AF 30(602)-2998)
(RADC-TR-64-552; AD-615504)

This report describes some studies and experiments performed to develop a color film which is responsive to a magnetic field. The film consists of randomly positioned particles of magnetostrictive material with outer shells of brittle metallic coatings. By applying a small external magnetic field ($\sim 7-8 \times 10^{-3}$ oersteds) to the film, the magnetostrictive material changes size and shape such that the coatings break and allow chemical reactions which result in colors. The investigation includes studies and experiments with magnetostrictive, transparent and brittle coatings and color forming chemicals. Author

N65-30213 Library of Congress, Washington, D. C. Aerospace Technology Div.
NEW BINARY SEMICONDUCTOR COMPOUNDS OF LANTHANUM
John G. Kourilo *In its* Foreign Sci. Bull., Vol. I, No. 7 Jul 1965 p 27–30 refs (See N65-30207 19-34)

Recent Soviet experimental studies of lanthanwn chalcogenides, silicides, and germanides are reviewed. The existence of $LaSi_{2-n}$*, La_3Si_2, and La_4Se_7 compounds was revealed for the first time. The crystal structure of known binary compounds in the La–Si, La–Ge, and La–Se systems was determined, and methods were developed for preparing these compounds. The compounds $LaSi_2$, $LaSe_2$, and La_2Se_3 were singled out as potential high-temperature semiconductor materials, and $LaGe_2$, as a thermally stable material with a crystal type similar to that of $LaSi_2$. Author

N65-30317 IIT Research Inst., Chicago, Ill.
EXPERIMENTAL CONFIRMATION OF PRECIPITATION AND OXIDATION IN EVANOHM CONDENSATE THIN FILMS
David W. Levinson (Illinois Univ., Chicago), and Robert G. Stewart *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 281–305 refs (See N65-30300 19-09)
(Contracts AF 30(602)-2731; AF 30(602)-3054; AF 30(602)-3251)

By electron and optical microscopic techniques, the precipitation out of the original solid solution of a phase based on Ni_3Al has been observed in the metal films condensed from the alloy Evanohm. A precipitation clustering of solute atoms causes a slight increase in the film resistivity. This is followed by a large decrease in resistivity as the solute content of the solvent or matrix is depleted by the growth of the solute rich precipitates. The rate of these processes has been observed to depend on the thickness of the film with the thinnest films aging fastest. The oxidation of these films has been studied using electron microscopy to identify the reaction and using a quartz crystal microbalance to determine the reaction kinetics. Prior to precipitation, a uniform Cr_2O_3 oxide layer grows with a limiting thickness, saturating form of kinetics. This is typical of a case where a retarding electric field is created in the oxide layer by the migration of the charged species which eventually halts the diffusion or oxidation process. Later, after clustering and precipitation has occurred, a particulate oxide identified as NiO grows with kinetics proportional to the cube of time. Author

N65-30319 Israel Inst. of Tech., Haifa.
MECHANISMS OF D-C ELECTRICAL BREAKDOWN IN THIN SILICONOXIDE FILMS
N. Klein, H. Gafni, and H. J. David *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 315–332 refs (See N65-30300 19-09)

Breakdown was investigated on capacitors produced by vacuum deposition on glass slides. Dielectric thickness varied from 1000 to 10,000 Å and the aluminum electrodes were a few hundred angstroms thick. Breakdown events were not shorting, punching an opening through dielectric and electrodes. Single holes are produced below a voltage limit, while above the limit breakdowns destroy large areas. The voltage versus time oscillograms of these two events are different. Rate of breakdown events increases rapidly with voltage. On application of certain voltage, breakdown events continue for some time at a decreasing rate. Increase of humidity and decrease of the external resistance in series with the capacitor increase considerably the frequency of breakdown events. Development of breakdown events with time is ascribed to their nature as thermal breakdowns. The decrease of breakdown strength by humidity is ascribed to the filling of cracks by capillary water. Such cracks constitute high conductance channels in the dielectric and are prone to thermal breakdown. Author

N65-30320 Research Triangle Inst., Durham, N. C.
GALVANO-DIFFUSION EFFECT IN THIN FILM METAL DIELECTRIC STRUCTURES
J. J. Wortman and R. M. Burger *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 333–341 refs (See N65-30300 19-09)

This paper describes studies of galvano-diffusion phenomena. It has been found that a voltage is generated between the metal electrodes of a thin film metal-dielectric-metal sandwich. A necessary requirement for the phenomenon is ionic diffusion through the dielectric accompanied by an oxidation of one of the metal films. The ionic diffusion is characterized by an activation energy which is characteristic of the dielectric material. The process involves the diffusion of metal ions through the dielectric which then results in a chemical reaction. The electrical circuit is completed by an external load resistor which provides a path for electron flow. It has been possible to experimentally correlate the rate of consumption of metal ions (increase in dielectric thickness) with the integrated electron flow through the load resistor. The test vehicle consisted primarily of Al–Al_2O_3–Au devices. Tests have been performed to determine the effect of electrode thickness (both Au and Al) and dielectric thickness on the diffusion rate. Author

N65-30328 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
INVESTIGATION OF SURFACE BREAKDOWN BY LIGHT SCANNING
W. W. Hooper and W. Schroen *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 433–451 refs (See N65-30300 19-09)
(Contract AF 30(602)-3016)

Experimental investigations of surface breakdown in planar p-n junctions ut lizing the technique of photoscanning are reported. A reduction in device breakdown voltage upon illumination of small areas of the oxide layer close to the p-n junction has been observed. The results suggest conclusions about failure mechanisms in oxide covered silicon p-n junctions and possible methods to prevent them. A model is presented which describes the variation of the breakdown voltage by dividing the space charge layer near the interface into two regions: an ionization region containing a high electric field, and a trapping region. It is assumed that the electrons generated by the illumination change the charge state of the traps in such a way that the electric field within the ionization region is increased. Author

N65-30329 Rome Air Development Center, Griffiss AFB, N. Y.
RELIABILITY PHYSICS AT RADC
Joseph Vaccaro *In* RADC Phys. of Failure in Electron., Vol. 3 Apr. 1965 p 452–480 refs (See N65-30300 19-09)

The objectives, approach and current status of a reliability physics program are summarized in this paper. Limitations and potential contributions of failure mechanism studies in predicting and measuring the reliability of electron devices is assessed. The experimental and analytical complexity of such studies is recognized, but the necessity for augmenting any major military reliability program with efforts of this type is maintained. Author

N65-30411 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUILIBRIUM OF A TWIN FOR PLANE SURFACE OF ISOTROPIC MEDIUM
A. M. Kosevich and L. A. Pasmur *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 113–121 refs (See N65-30400 19-23)

A dislocation model of quasi-static twinning on the surface of a crystal is considered. Also, the general qualitative phenomenon of hysteresis is discussed. It is assumed that the twin is infinite in one direction parallel to the crystal surface. Equations are derived for the quasiequilibrium development of the thin twins. Further, the stability of twins at the crystal surface is considered. E.E.B.

N65-30412 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON STRAIN WAVES IN DURABLE ROCKS
Ye. I. Shemyakin *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 122–138 refs (See N65-30400 19-23)

The propagation and characteristics of short strain waves in solid media (limited and elastic) during dynamic loading was studied. Presented are results of an analysis of spherical, cylindrical, and plane waves, in which the theory of short waves was used. S.C.W.

N65-30413 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE EQUATION OF STATE OF SOLID BODIES
V. M. Gogolev, V. G. Myrkin, and G. I. Yablokov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 139–148 refs (See N65-30400 19-23)

The thermodynamic properties of strong shock waves in solid bodies were studied using single shock adiabat calculations and a theoretical model in Debye approximation. Presented are results of a generalization of experimental data on shock compression of metals, rocks, and other solid materials. Derived are generalized equations of state, internal energy, entropy, and other thermodynamic relationships which can be used to approximate the properties of other hard, nonporous, materials. S.C.W.

N65-30488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING THE EFFECT OF GAMMA-RAYS, X-RAYS AND NEUTRONS ON ELECTRIC PROPERTIES OF CdS-Se AND CdSe-Se RECTIFYING SYSTEMS
M. A. Talibi and G. B. Abdulayev 7 May 1965 4 p. Transl. into ENGLISH from Fotoelektr. i Optich. Yavleniya v Poluprov. (Kiev), 1959 1 p
(FTD-TT-64-1389/1; AD-615868)

The effects of light, gamma rays, X-rays, and neutrons were studied on semiconducting rectifier systems of selenium doped cadmium sulfide and cadmium selenide. The results indicate that quantum energy of radiation is not related to the effects (volt-ampere, volt-ohm, lux-ampere, etc.) produced. TAB

N65-30574# Japan Atomic Energy Research Inst., Tokyo.
ACTIVATED SINTERING OF URANIUM DIOXIDE FUEL. (III) MEASUREMENT OF LATTICE CONSTANTS BY X-RAY
Kunio Suzuki, Kazuo Maruya, and Tadashi Kubota Jan. 1965 10 p refs Transl. into ENGLISH from Nippon Genshiroky Gakkaishi (Tokyo), v. 5, no. 7 Jul. 1963 p 587–592 Presented (NSF-TR-5)

Lattice-constant measurements by X-ray of the various UO_2 pellets, lead to the results: (1) The lattice constant of UO_{2+x} is $a = (5.4701 - 0.05x) \pm 0.002$Å, where x ranges $0 \approx 0.09$. (2) By being sintered at 1,500°C for 2 hr, UO_2 pellets containing excess oxygen are reduced to $UO_{2.00}$ in either dry or wet hydrogen, whereas in vacuo a minute amount of excess oxygen remains in the sintered pellets. (3) In UO_2, TiO_2 (or lower oxide) is soluble, BeO practically insoluble, Al_2O_3 completely insoluble, and M_gO slightly soluble. With the last additive, the formation of solid solution depends largely upon the amount of excess oxygen of UO_2. 6p, 5f, 4t (auth.) Author

N65-30604# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
PHOTOPEAK EFFICIENCIES FOR NaI(Tl) CRYSTALS FOR POINT AND EXTENDED SOURCES
R. J. Finn Oct. 1964 18 p refs
(AAEC/TM268)

This report gives a series of calibration curves which relate the photopeak counting rate in NaI(Tl) crystals to the number of photons being emitted by the radioactive source. The curves cover the energy range of 0.3–1.5 MeV for 8-in dia. × 4 in, 5-in dia. × 4 in, and 3-in dia. × 3-in NaI(Tl) crystals. The geometries considered are: (1) point sources 5 mm from the crystal face, (2) 3.1/2-in dia. × 1/2 in petri dishes placed centrally on the face of the larger crystals, (3) a one-inch thick source surrounding the top face and sides of the 5-in dia. × 4 in crystal, and (4) for the 8-in dia. × 4 in crystal, a 5.1/2-in diameter bottle containing 2400 cm^3 of liquid placed centrally on the face of the crystal. Author

N65-30608# Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
MOBILITY OF CHARGE CARRIERS IN SILICON CARBIDE
H. J. van Daal (Thesis–Amsterdam Univ.) 1965 97 p refs
Its Res. Rept. Suppl. No. 3

The electrical conductivity and the Hall coefficient are measured in the temperature range from 78° K to 1300° K on p- and n-type hexagonal and cubic SiC crystals. The electric field has a direction perpendicular, the magnetic field a direction parallel to the c-axis in the case of hexagonal and to the [111]-axis in the case of cubic crystals. The measurements have been performed with the aid of the four-point method of Van der Pauw. The systematic error, introduced when the size of the contacts is no longer negligibly small in comparison with the dimensions of the sample, is established. The influence on the measurement of inhomogeneities in the sample is examined. It is found that in most of the samples investigated the ratio of the Van der Pauw resistances R_1 and R_2 starts to change towards lower temperatures. It is established by using a divergent X-ray-beam technique that such samples are crystallographically inhomogeneous. An analysis of the mobility is only performed on those crystals for which the ratio R_1/R_2 is constant or starts to change only at a relatively low temperature. The method of making electrodes on SiC crystals, the construction of a sample holder, and the furnace system and cryostatused in the measurements are described. Author

N65-30646# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
PHYSICAL PROPERTIES OF UO_2 SINGLE CRYSTALS
S. Amelinckx et al Brussels, EURATOM, 1965 58 p refs
(Contract EURATOM-063-61-10 RDB)
(EUR-1414.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 100 Belg. Fr.

In order to determine the optimum composition for preparing single crystals of UO_2, the excess oxygen content in the starting material was systematically measured. A study was made of the kinetics of the oxidation reduction reaction UO_2 to UO_{2+x}. Sintering experiments were devoted to the accurate measurement of the necks developed between single crystalline spheres. In diffusion experiments, a method was developed for the plane parallel removal of layers of about 0.3 micron thickness. Precipitates in quenched crystals of UO_2 and fission track formation during irradiation were investigated. The formerly used method of heat conduction for measuring low temperatures was modified. Measurements of the thermoelectric power of a series of UO_2 crystals with different excess oxygen content were continued. Electrical conductivity recovery was studied after reactor irradiation in the temperature range between 125° and 1120° K. A pronounced annealing peak was found around 725° C. The strong coupling polaron theory of Pekar was applied to an exactly soluble model where the electron interacts with a single lattice oscillator. R.N.A.

N65-30653# India. Dept. of Atomic Energy, Bombay. Nuclear Physics Div.
CDC-3600 FORTRAN CRYSTALLOGRAPHIC PROGRAMS FOR NEUTRON DIFFRACTION, PART I-NP-SFLS 1
S. Srikanta 1965 35 p
(AEET-203)

This report describes in detail the CDC-3600 computer program for the least squares refinement of crystal structure parameters based on neutron diffraction measurements. The complete program, written in Fortran language, is for refining two dimensional data with isotropic temperature factors. This program can be easily modified for refining three dimensional data and with anisotropic temperature factors. Author

N65-30683# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
TEMPERATURE DEPENDENCE OF THE EFFECTIVE MAGNETIC FIELDS IN SPINEL TYPE FERRITES STUDIED BY THE MOSSBAUER EFFECT [BADANIE TEMPERATUROWEJ ZALEZNOSCI EFEKTYWNYCH POL MAGNETYCZNYCH W FERRYTACH O STRUKTURZE SPINELU METODA EFFEKTU MOSSBAUERA]
A. Z. Hrynkiewicz, D. S. Kulgawczuk, and K. Tomala Apr. 1965 10 p refs Submitted for Publication
(Rept.-407/PL)

The effective magnetic fields for the Fe^{3+} in ferrites $NiFe_2O_4$, $CoFe_2O_4$, $MnFe_2O_4$ and $MgFe_2O_4$ was measured. The average magnetic fields for the two sublattices at 0° K obtained by extrapolation are, in the limit of experimental error, the same for the investigated compounds and amount to about 530 kOe. The temperature dependence of H_{eff} for $NiFe_2O_4$ is in good agreement with the Brillouin curve for the average molecular field. Author

N65-30684# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE USE OF DIRECTIONAL FREEZING OF THE MELT FOR BISMUTH LARGE SINGLE CRYSTALS PREPARATION [ZASTOSOWANIE KIERUNKOWEJ KRYSTALIZACJI ROZTOPIONEGO METALU DO OTRZYMANIA DUZYCH MONOKRYSZTALOW BIZMUTU]
S. Bednarski Dec. 1964 12 p refs Submitted for Publication
(Rept.-567/II/PS)

Directional freezing of melted metal has been used for bismuth large single crystals preparation. The diameter of cylindrical crystals obtained by this technique is 75 mm and the length 180 mm, the average mosaic spread is about 10 minutes of arc. The described technique may be applicable to single crystal growing of some other materials which increase their volume during the solidification process. Author

N65-30704# Minnesota Univ., Minneapolis.
ELECTRON SPIN RESONANCE STUDIES OF SELECTED SOLIDS Final Report
T. M. Sanders, Jr. [1961] 39 p refs
(Contract AF 49(638)-811)
(AFOSR-65-0852; AD-616788)

Electron spin resonance experiments on shallow donors in germanium are reported. The experiments consist in measurements of the Zeeman effect of the donors as a function of applied [110] compression. From the data a value may be derived for the valey-orbit (singlet-triplet) splitting ($4\Delta_c$) of the donor

ground state. The results for P donors agree with determinations by other workers. The result for Sb in Ge is $4\Delta_c = (4.04 \pm 0.1) \times 10^{-4}$ ev. This result is not consistent with the value obtained from piezo-resistance measurements. The data also require that the singlet state lie below the triplet in Sb-donors, just as in P and As donors. An additional four-line spin resonance spectrum in Sb-doped Ge is ascribed to donors located near the surface of the samples, in regions of high local strain. Author

N65-30774# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DERIVATION OF AN INTERSTITIAL POTENTIAL FUNCTION FOR A FACE-CENTERED CUBIC CRYSTAL FROM FIRST PRINCIPLES
John Eugene Wrobel, Jr. (M.S. Thesis) Feb. 1965 117 p refs
(SP/PH/65-20; AD-616688)

An interstitial potential function for an fcc crystal was derived by series expansions of 1/r in terms of Fourier exponentials, Legrendre polynominals and cubic harmonics of the type alpha. In particular, a function having the form of an empirical function suggested by J.C. Slater and P. DeCicco of M.I.T. was derived by the series expansions. This derived function not only gives the Slater-DeCicco empirical constants in terms of known functions, but also generates higher order terms. The series expansion for the interstitial potential is found to converge very poorly. For example, after five hundred terms, it is convergent to only three significant places. Furthermore, the function is not entirely analytical, being expressed in terms of the number of lattice points in an fcc reciprocal lattice for a given wave vector magnitude. These numbers are not analytical functions of the wave vectors but a simple method for determining them is given. Author

N65-30782# Stanford Research Inst., Menlo Park, Calif.
GROWTH AND CHARACTERIZATION OF β-SILICON CARBIDE SINGLE CRYSTALS Scientific Report No. 1, May 1964–Feb. 1965
F.A. Halden, A. Rosengreen, and W. E. Nelson May 1965 26 p refs
(Contract AF 19(628)-4910)
(AFCRL-65-206; AD-616637)

The process for growing β-silicon carbide single crystals from solution in carbon-saturated silicon melts was examined to determine how larger crystals may be obtained. It appears that crystals grown to date have been limited in size by the small volume of the supersaturated zone provided for crystallization and by the presence of unstable boundary layers at the crystal growth interface. Means for removing these limitations are suggested. Electron mobilities in the range of 500 to 900 cm^2/vsec were obtained on relatively large crystals having resistivities of about 0.1 ohm-cm. Smaller crystals having resistivities of approximately 1 ohm-cm had mobilities in the range of 1000 to 3000 cm^2/vsec. However, since on these crystals the size of contact spots is large compared with intercontact spacings and the correction factors thus affect the resultant value strongly, it is not at present possible to give precise values of mobility and resistivity. Author

N65-30784# Brown Univ., Providence, R. I.
AN INVESTIGATION OF THE PHOTOVOLTAIC EFFECT ASSOCIATED WITH A LIFETIME GRADIENT IN A SEMICONDUCTOR
R. M. Esposito Wright-Patterson AFB, Ohio, ARL Apr. 1965 72 p refs
(Contract AF 33(657)-8974)
(ARL-65-74; AD-616764)

The photovoltage due to a lifetime gradient in a semiconductor is investigated. Equations for small signal and large signal cases are presented. Methods of producing lifetime changes are discussed. These include diffusion of impurities and irradiation by high energy particles. Attempts were made to observe the effect as produced by the latter method. Types of bombarding particles included 300 KeV protons, 400 KeV electrons and 3 MeV electrons. The result of each attempt is discussed in detail. An effect whose origin has not been unequivocally established has been observed. Its sign is opposite to that predicted by theory for the lifetime effect. Calculations indicate that it is probably not caused by resistivity differences between the two sections of the sample. Suggestions are offered for possible future experiments. Author

N65-30797# Stanford Univ., Calif. Microwave Lab.
MILLIMETER GENERATION AND NONLINEAR PROPAGATION IN FERROMAGNETICS Final Report, 1 Jul.–30 Sep. 1964
Apr. 1965 40 p refs *Its* Rept. No. 8
(Contract DA-36-039-AMC-0041 (E))
(ML-1313; AD-616743)

1. An investigation of pressurized nitrogen primary spark gaps, which was started during the preceding quarter, was completed during the last quarter, together with various related components. These were found to overcome difficulties experienced earlier in the year with atmospheric pressure gaps, and to provide substantially improved pulsed field waveforms. This work is described in the text of this report. 2. An investigation of resonant-slot output coupling circuits, begun during the past quarter, has been completed. Bench testing of prototypes and construction of final models were carried out, as described in the text below. 3. Construction is nearly complete on an experimental type II generator using the components of 1 and 2 above, which will be tested during the coming quarter. Author

N65-30803# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
GLOSSARY OF ELECTRONIC PROPERTIES
Emil Schafer Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 91 p
(Contracts AF 33(615)-1235; AF 33(615)-2460)
(S-7; AD-616783)

A glossary of electronic property indexing terms has been prepared. In addition, definitions are given for those terms subsumed under the main property entry term. A detailed list of cross-references and subsumed terms provides a complete index to the glossary and to the property term under which data has been indexed. Author

N65-30852# Massachusetts Inst. of Tech., Cambridge.
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report
15 Jul. 1965 69 p refs
(Contracts Nonr-1841(34); AF 19(628)-356; Grants NSF G-24908; NSF GP-3241; NSF G-10821)
(QPR-57; AD-617792)

An iterative band calculation was used to obtain the cohesive energy formula of a KC1 crystal in terms of one-electron energies, potentials, and charge densities. The calculated value of -167.8 ± 5 Kcal/mole differed very little from the experimental value of -167.8 ± 2 Kcal/mole. Results from augmented plane wave calculations of the energy bands of hexagonal close packed beryllium were used to obtain the Fermi surface of beryllium. The theoretical Fermi surface agreed well with experimental results. Work on molecular integrals and their

improved formulation continued. Calculations of the magnetic impurity effect on the superconductor transition temperature found that no finite magnetic impurity concentration can prevent the transition to the superconducting state as long as the temperature is low enough. G.G.

N65-30861# Naval Research Lab., Washington, D. C.
AN EXPLORATORY STUDY OF RADIANT ENERGY TRANSPORT IN BeO
E. J. Chapin and D. G. Howe 22 Mar. 1965 72 p
(NRL-6195; AD-616892) CFSTI: $2.00

Current hypotheses on the contribution of radiant energy to heat transfer in BeO were reviewed. The problem of radiant energy transmission in BeO was explored in high vacuum by exposing simultaneously, two types of BeO sample materials heated at temperatures from 1000° to 2000° C, to pulses of radiant energy of known intensity emitted from a tungsten wire source. The effects were monitored with potentiometers and oscilloscopes from emf signals generated by thermocouple detectors. Thin-walled translucent BeO tube material exhibited no major transmission of radiant energy at temperatures of 1000° to 2000° C when exposed to pulses of high-intensity radiant energy. Oscilloscope data showed, however, an initial effect from incident radiant energy intensity. The radiant energy transfer in granular fused BeO was explored simultaneously with that in the BeO tube material. The overall results obtained indicated that hot BeO did not become progressively diathermanous as its temperature increased but rather it displayed a stronger opaque behavior toward radiant energy. Author

N65-30917# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
MULTIPHONON PROCESSES IN THE PHOTOCONDUCTIVITY OF SINGLE CRYSTALS OF CADMIUM SULFIDE AND CADMIUM SELENIDE AT 2.4°K
James A. Bell (M.S. Thesis) Mar. 1965 89 p refs
(GSP-65A; AD-616683)

The photoconductivity of single crystals of CdS and CdSe was investigated at 4.2° K to ascertain whether the multiphonon process does exist in CdSe, to provide additional evidence of this previously observed phenomenon in CdS, and to show that similar electron and phonon processes were responsible for the multiphonon process in both crystals. Analysis of data has indicated that the multiphonon process does exist in CdSe and that the multiphonon process in both CdS and CdSe can be attributed to similar electron and phonon processes. It was observed in the CdSe data that both free exciton and bound exciton states could act as recombination centers for the multiphonon process; only free excitons seemed to do so in CdS. Author

N65-30953*# Research Triangle Inst., Durham, N. C.
EFFECT OF MECHANICAL STRAIN ON p-n JUNCTIONS
J. B. Wortman Washington, NASA, Aug. 1965 117 p refs
(Contract NASR-222)
(NASA-CR-275) CFSTI: HC $4.00/MF $0.75 CSCL 20L

A theory is developed for the effect of mechanical strain on the electrical characteristics of germanium and silicon p-n junction devices. The model is based on the deformation potential theory of semiconductors which accounts for strain-induced changes in the energy band structure. Changes in the minority carrier densities are found to cause the major changes in the electrical characteristics. The changes in the energy structure and hence the minority carrier densities are shown to depend upon the type of stress applied, with anisotropic stresses causing larger changes than hydrostatic stresses. Equations which are based on the energy changes are developed for the current-voltage characteristics of diodes and transistors under stress. The results of an experimental investigation are reported. Experiments were carried out on mesa diodes, planar diodes and transistors. The theory is compared with the experimental data and is found to be in good agreement. Author

N65-30963# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EFFECTS OF UNIAXIAL STRESS UPON THE VISIBLE RUBY ABSORPTION SPECTRUM
Guy Calvin Spitale (M.S. Thesis) Jun. 1965 130 p refs
(SP/PH/65-10; AD-616740)

An investigation of the effects of uniaxial stress upon the ruby absorption spectrum was conducted using a photographic technique. To reduce the effects of thermal broadening of spectral lines, ruby samples were immersed in liquid nitrogen. A heretofore uninvestigated series of satellite aborption lines was found near the red doublet. Intensity is dependent upon the concentration of chromium in the lattice. This suggests that the newly observed lines are caused by exchange interactions between chromium ions. The effects on these lines of uniaxial stress was measured as a function of polarization and orientation of the c-axis. A linear dependence of spectral line position on stress, a general shift of all lines toward the red, and a marked splitting of the satellites were observed. A theoretical analysis from the point of view of crystalline field theory was conducted in the weak field scheme. TAB

N65-30964# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LENGTH CHANGE MEASUREMENTS OF ELECTRON IRRADIATED CADMIUM SULFIDE IN THE ENERGY RANGE 275–935 KEV
Stephen Pierce Richard (M.S. Thesis) Jun. 1965 73 p refs
(GSP-65B; AD-616684)

Single crystal cadmium sulfide was bombarded 275-935 keV electrons from a Van de Graaff accelerator and the change in length was observed at room (295° K) and liquid nitrogen (77° K) temperatures. The crystal showed a barely detectable change in length, $(-5.7 \pm 7.6) \times 10^{-22}$ per electron per cm^2, when bombarded with electrons below the cadmium displacement threshold at 295° K. Above the cadmium threshold an initial contraction not predicted by the simple displacement theory of the order of (-6.0×10^{-3}) was observed. After the initial contraction, at 550 keV the length change was $(+1.0 \pm 9.8) \times 10^{-23}$ per electron per cm^2, while at 755 and 935 keV the length changes were $(+4.6 \pm 1.5) \times 10^{-22}$ per electron per cm^2 and $(-1.5 \pm 2.6) \times 10^{-22}$ per electron per cm^2, respectively. These length changes show the effect of an annealing stage which becomes dominant at large concentrations of displaced cadmium atoms. Author

N65-30996 Joint Publications Research Service, Washington, D. C.
EXPERIMENTS ON THE CONTINUOUS INFRARED STIMULATED EMISSION OF FLUORESCENT CaF_2: Dy^{2+} CRYSTALS
Sung-hao Liu, Fu-kuei Wang, P'ei-hui Liang, and Kuei-fen Chang *In its* Transl. on Communist China's Sci. and Technol., no. 202 9 Aug. 1965 p 74–84 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 5, May 1965 p 447–451 (See N65-30991 19-34) CFSTI: $4.00

An output of more than 2 watts of continuous infrared stimulated emission was obtained from a roughened calcium fluoride: dysprosium^{2+} crystal rod in a tungsten filament discharge lamp. Crystal emission power outputs in tungsten filament lamps filled with iodine were 2 to 3 times higher than those in vapor filled discharge lamps. It was found that the

fluorescent intensity of the crystal influenced its internal temperature and thus limited the maximum stimulated emission to 2500 watts for an iodine filled tungsten lamp. Heat treatment of the oxidized crystals made them reusable but produced some changes in their optical region absorption spectrum. G.G.

N65-31016# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
RESEARCH INTO NEW APPROACHES FOR VHF FILTER CRYSTALS Quarterly Summary Report, 1 Aug. 1964–15 Jan. 1965
D. R. Curran and D. J. Koneval 5 Apr. 1965 92 p refs
(Contract DA-36-039-AMC-02245(E))
(QSR-6; AD-617187)

Energy trapping theory has been applied to obtain a normalized expression relating harmonic overtone modes and the inharmonic overtone series associated with each, for idealized thickness shear and thickness twist modes, to a resonator design parameter which includes both electrode dimension and effective electrode mass-loading. From this, a generalized resonator design criterion is proposed. A major series of experiments with fundamental, 3rd, and 5th overtone resonators at 10, 30, and 50 Mc has been performed to confirm theory and obtain improved values for the generalized resonator design criterion. These principals have been used to obtain substantial improvement in performance for resonators at 10, 30, 60, and 90 Mc in several structural configurations. Author

N65-31153# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development.
X-RAY EFFECTS CAUSED BY DEFECTS IN METALS Final Report
F. R. L. Schoening and F. Witt Apr. 1964 27 p refs
(Contract AT(30-1)-2994)
(F-B1979-2; NYO-2994-2)

This report describes a method to predict and measure static lattice distortions in titanium as produced by interstitial atoms. It is assumed that the metal can be approximated by a continuum having the elastic properties of titanium and that the interaction of the interstitial atom with the crystal lattice can be represented by a set of crossed unequal double forces which act along the principal axes of a cartesian coordinate system in the crystal. The doublets act normal to the surface of a small sphere cut out at the position where the interstitial atom is situated in the crystal, and the basal plane doublets are assumed to be of equal magnitude. The influence of thermal vibrations on the diffracted intensity has been measured both at room temperature and at liquid nitrogen temperature. The characteristic temperature has been determined as a function of the defect concentration. Author

N65-31205# Carson Labs., Inc., Bristol, Conn.
RESEARCH TO DEVELOP TECHNIQUES FOR OPTICAL ANALOG MULTIPLICATION OF LARGE SCALE MATRICES Scientific Report No. 1
Richard A. Knapp Jul. 1965 58 p refs
(Contract AF 19(628)-4311)
(AFCRL-65-493; AD-617961)

Series of investigations in which the applicability of several optical processes which take place in alkali halide crystals to the problem of optical analog multiplication of large scale matrices was determined. Experiments were (1) measurements to determine several low temperature properties of F and F' centers in KCl and KBr; (2) experiments on the formation, stability, and optical removal of complex centers in hydrogenated KCl; (3) investigations of the intensity dependence of room-temperature F center bleaching in hydrogenated KBr; (4) and semi-quantitative measurements of the optical thickness changes caused by room-temperature ultraviolet generation of F centers in hydrogenated KBr. A discussion of methods of performing optical multiplication, and a brief review of color centers in alkali halide crystals, are included. Methods of preparing additively colored alkali halide crystals, and the development of a computer program to perform certain color center calculations are described. Author

N65-31208# California Univ., Berkeley. Lawrence Radiation Lab.
ON THE FORMATION OF DONOR-LIKE COMPLEXES IN DIFFUSED SILICON DEVICES
R. Y. Deshpande 15 Jun. 1965 54 p refs
(Contract W-7405-ENG-48)
(UCRL-16197) CFSTI: $3.00

In this paper we describe an extensive study on the electrical characteristics of diffused silicon devices. A general survey of the work in the field is followed by a description of the effect of various heat and ambient treatments on the properties of silicon–silicon dioxide. The conductivity of the interface was measured as a function of temperature, and from the results the activation energies of the various impurity levels introduced by these treatments were determined. Some of the electrical parameters of the interface were also calculated. We then propose a model based on the formation of donor-like complexes at the $Si\text{-}SiO_2$ interface. A possibility of the bulk properties influencing the electrical characteristics of the interface is also suggested. The point is further investigated by means of the method of double injection in long diffused p^+pn^+ silicon diodes. We also suggest that some of the bulk effects are transferred onto the interface. The characteristics of some diffused silicon devices are finally discussed in the light of these observations. Author

N65-31238# Los Alamos Scientific Lab., N. Mex.
AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. VIII: THERMAL ELLIPSOID ORIENTATION
Allen C. Larson, R. B. Roof, Jr., and Don T. Cromer 6 Aug. 1965 32 p ref
(Contract W-7405-ENG-36)
(LA-3310) CFSTI: $2.00

The procedures employed and the computer program used for determining the principal axes and the orientation of anisotropic thermal ellipsoids relative to crystallographic axes are described. This information is often useful in correlating the thermal vibrations of the atoms of a single crystal with its various other physical properties. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-30742# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON UNSTABLE COMBUSTION IN SOLID PROPELLANT ROCKETS Annual Report, Jan. 1–Dec. 31, 1964

L. A. Dickinson, E. L. Capener, and R. J. Kier 13 Jan. 1965 71 p
(Contract AF 49(638)-1367; ARPA Order 317)
(AD-612178)

Initiation of axial combustion instability in an experimental combustor, 40 inches long by 50 inches I.D., containing a radial burning grain, has been studied utilizing a wide variety of composite propellants. Where instability occurred, a correlation was found between the threshold pressure at which instability was first observed and propellant ballistic parameters, notably the linear burning rate. Fast burning propellants, containing either a catalyst or potassium perchlorate, did not sustain axial mode combustion instability. Transverse instability was observed for most non-aluminized propellants in pressure regimes where they were stable to axial combustion instability. An explanation of combustion stability criteria has been sought in terms of either mixing processes within a granular diffusion flame or a thermal explosion process. The granular diffusion flame concept appears thus far to be the more promising explanation; it predicts the stability trends observed in large solid propellant rocket motors. Author

N65-30860# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Biomedical Lab.
MICROBIAL ACTIVITY IN AIR FORCE JET FUEL SYSTEMS Technical Report, Feb. 1963–Apr. 1964
Sheldon A. London, Viola H. Finefrock, and Lawrence N. Killian (Systems Res. Labs.) Apr. 1965 31 p refs Prepared jointly with Systems Res. Labs., Inc.
(Contract AF 33(657)-11733)
(AMRL-TR-65-30; AD-616648)

Malfunctions and changes occurring in JP-4 fuel systems have been attributed to the presence of microorganisms. The known capability of microbial entities to utilize hydrocarbon products as a carbon source has been considered as a priori evidence of a direct cause-effect relationship in the deterioration of jet fuel systems. The direct implication of microbes in the deterioration of Air Force jet fuel systems has not been proved unequivocally. The U.S. Air Force, as well as the Navy and Army, have instituted research programs to determine the specific changes caused by bacterial and fungal growth in JP-4 and the contributory factors which promote or retard their activities. The presence of contaminating microbes was shown to occur only in association with free water. Microbial corrosion of various aluminum alloys has been demonstrated in the laboratory, but poor reproducibility attests to the lack of understanding of this phenomenon. The efficacy of the anti-icing additive, ethylene glycol monomethyl ether (EGME), as a microbial inhibitor has been well documented. Although a low level of viable microorganisms continues to be observed in Air Force fuel systems, the application of good housekeeping and the effect of EGME appear to have controlled their activity. Author

N65-31009# Stanford Research Inst., Menlo Park, Calif.
IGNITION OF SOLID ROCKET PROPELLANT SURFACES Semiannual Technical Report, 1 Dec. 1964–31 May 1965
Donald Baker Moore and Marjorie W. Evans 15 Jul. 1965 30 p refs
(Contract NOw-65-0198-d)
(SATR-1; AD-467175)

Research is being conducted to improve the precision of experiments in which ignition characteristics of solid rocket propellants are measured and to determine the surface ignition behavior of simple chemical systems for testing hypotheses and relating theory to results. The arc image ignition furnace and associated measurement equipment; including electrical instrumentation, arc stability, shuttering, and attenuation techniques; were modified. Improvements were made on calibration and measurement precision in the areas of calorimetry and flux mapping. Ignition characteristic measurements were partially completed for ammonium perchlorate–carbon–copper chromite samples. Model propellant samples were prepared for testing. R.N.A.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-30482*# Electro-Optical Systems, Inc., Pasadena, Calif.
POWER CONDITIONING AND CONTROL SYSTEM Interim Design and Development Report
W. H. Payson 1 Jun. 1965 94 p Prepared for JPL
(Contracts NAS7-100; JPL-951154)
(NASA-CR-64161; EOS-6780-IR-1) CFSTI: HC $3.00/MF $0.75 CSCL 21C

Design considerations for a power conditioning and control system for a cesium bombardment ion engine for use in a solar electric propulsion spacecraft are presented. Discussed are the circuitry for: (1) the power supplies that provide the arc, vaporizer, magnet, valve, and reservoir heater; (2) the positive and negative high voltage supplies that furnish power to the ion beam and accelerator electrode; (3) the programmer that provides the sequencing required for operation of the engine; (4) the instrumentation and signal conditioning; and (5) the packaging techniques for laboratory testing. Areas are pointed out in which compromises are required for best meeting both the test constraints and the proper representation of a spacecraft electric propulsion system. Graphs, charts, tables, circuit diagrams, and system block diagrams are included. L.S.

N65-30849*# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
INSTALLED PERFORMANCE OF AIR-AUGMENTED NOZZLES BASED ON ANALYTICAL DETERMINATION OF INTERNAL EJECTOR CHARACTERISTICS
Helmut H. Korst, Alva L. Addy, and W. L. Chow [1964] 35 p refs
(Grant NGR-14-005-032)
(NASA-CR-64301) CFSTI: HC $2.00/MF $0.50 CSCL 21H

In this paper, procedures for matching intake and ejector pumping characteristics are outlined for either experimentally or theoretically available intake performance information. In addition, the influence of external aerodynamics such as flow over the boattail and its interactions with the internal ejector performance are considered. The present method is illustrated by applying the theoretical analysis to an air-augmented jet engine model investigated by NACA. Excellent agreement between theoretical and experimental data is obtained for static operation; in addition, the theoretical model also allows to predict analytically the in-flight performance of the ejector nozzle configuration. N.E.A.

N65-30954*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT-TEST TEMPERATURE DATA FOR AN ALTAIR-NC1 ROCKET MOTOR

James L. Raper Washington, NASA, Aug. 1965 28 p refs (NASA-TN-D-2953) CFSTI: HC $2.00/MF $0.50 CSCL 21H

Comparison of chamber-wall temperatures obtained from flight data and static tests at altitude shows some differences. The flight data indicate maximum chamber-wall temperatures of 800° F as compared with maximum temperatures of 400° F for static tests on the chamber wall at simulated altitude. Comparison of static data for a foil-wrapped and a nonwrapped chamber indicates foil wrapping causes an increase in temperature from 400° F to 700° F. Flight temperatures are sufficiently high to cause epoxy resin boiloff, charring of the chamber wall, and resultant loss of chamber structural strength.

Author

N65-30960*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYTICAL INVESTIGATION OF THREE TURBOPUMP FEED SYSTEMS SUITABLE FOR HIGH-PRESSURE HYDROGEN–OXYGEN ROCKET-ENGINE APPLICATIONS

Richard J. Roelke Washington, NASA, Aug. 1965 30 p refs (NASA-TN-D-2974) CFSTI: HC $2.00/MF $0.50 CSCL 21H

Three turbopump feed systems were analyzed for possible use in a high-chamber-pressure hydrogen–oxygen rocket engine. The feed systems studied were the bleed, hot topping, and a combination of these two called a pressure-staged system. In the pressure-staged system, the hydrogen is pressurized in two stages by two separate turbopumps that utilize both bleed and topping turbines. The engine systems analyzed had a combustion chamber oxidant-fuel ratio of 7.0, chamber pressures from 1000 to 4000 pounds per square inch absolute, turbine inlet temperatures of 1400° and 1800° R, and turbine-exhaust thrust-recovery factors of 0 and 0.5. The analysis showed that the bleed rate of the bleed system, with two-stage turbines at an inlet temperature of 1800° R, increased approximately 1.7 percent for each increase in chamber pressure of 1000 pounds per square inch. The hot-topping system had no specific-impulse loss, and therefore, for a specified engine thrust and burning time, resulted in the minimum amount of vehicle propellant tankage of any of the feed systems analyzed. For any given chamber pressure, however, this system had the highest feed-system pressures. The differences in feed-system pressures of the three feed systems were small at a chamber pressure of 1000 pounds per square inch absolute but became considerable at higher chamber pressures. The analysis also indicated that the feasibility of the hot-topping system is dependent on a sufficiently high turbine inlet temperature.

Author

N65-31032*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

AN EXPERIMENTAL INVESTIGATION OF UNCOOLED THRUST CHAMBER MATERIALS FOR USE IN STORABLE LIQUID PROPELLANT ROCKET ENGINES

R.W. Rowley 15 Feb. 1964 29 p refs

(Contract NAS7-100)

(NASA-CR-64348; JPL-TR-32-561) CFSTI: HC $2.00/MF $0.50 CSCL 21H

An experimental investigation of the comparative merits of various uncooled thrust chamber materials was conducted by performing engine tests in which N_2O_4/N_2H_4 propellants were used at a nominal mixture ratio of 1.0. The chamber pressure was 150 psia and the nominal sea-level thrust was 85 lb. Erosion of graphites, ablative plastics, and refractory metals was found to be a function of the local thermal and chemical environments existing at the thrust chamber wall. The role of a particular impinging-stream injector in influencing local conditions at the wall was determined by (1) evaluating the properties of the spray produced by nonreacting liquids and (2) measuring local heat-transfer rates to the chamber wall in the operating rocket engine by means of embedded thermocouples and a transient conduction analysis. Local erosion, of Refrasil-phenolic, pyrolytic graphite, and ZT graphite nozzle throats tested with this injector was found to be qualitatively related to these local gas-side boundary conditions.

Author

N65-31033*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

STERILIZED SOLID-PROPELLANT ROCKET MOTORS FOR MARS LANDING MISSIONS Revision No. 1

L. C. Montgomery and H. E. Marsh, Jr. 30 Jun. 1965 21 p refs (Contract NAS7-100)

(NASA-CR-64351; JPL-TR-32-725) CFSTI: HC $1.00/MF $0.50 CSCL 21H

In the initial phase of the program to develop a sterile solid-propellant motor for planetary and lunar landings, the chemical approach was taken. Also, the chemical sterilization of a state-of-the-art propellant has been demonstrated. Current objectives, however, require the heat-sterilization approach. The ultimate test criterion for the heat sterilizability of a spacecraft component is the ability of the component to survive three cycles of exposure to 145° C for 36 hr. "Off the shelf" propellants from seven U.S. manufacturers were included in the initial tests. Three candidates were eliminated in initial sterilization cycle slump tests which were performed in both air and nitrogen atmospheres. The remaining four propellants having retained some integrity in the slump test are evaluated for the physical and ballistic changes that occur because of the sterilization treatment. The significant crusting of the propellants and its related physical effects are evaluated. The development of a silicone propellant for heat-sterilization application is also included.

Author

N65-31093# Michigan Univ., Ann Arbor. Infrared Physics Lab.

AN EXPERIMENTAL STUDY OF THE SHOCK STRUCTURE OF A JET EXHAUSTING FROM A HIGHLY UNDEREXPANDED SONIC NOZZLE

S. A. Crist, D. R. Glass, and P. M. Sherman Jan. 1965 36 p refs

(Contract ARPA SD-91; ARPA Order-236; Proj. Defender)

(Rept.-4613-79-T; AD-456093)

An experimental study has been made of the shock structure of a highly under-expanded axisymmetric jet exhausting from a sonic nozzle. The variables considered in this study were: ratio of stagnation pressure to ambient pressure, nozzle-exit geometry, ratio of specific heats, stagnation temperature, and the amount of condensation in the jet. The stagnation pressure varied from 150 to 15000 psi, and the ambient pressure varied from 2 mm to 760 mm of Hg. The resulting ratio range was of approximately 200 to 50000. Two nozzle geometries were used. Tests were made using nitrogen, helium, argon, and helium–argon mixtures in the jet, with the jet exhausting initially into an ambient atmosphere of air. For the jet, the ratio of specific heats was either about 1.40 or 1.667. Some tests were conducted at elevated temperatures. The results of these tests are compared with those achieved by semiempirical methods developed by earlier investigators for predicting the Mach disc location and the initial curved portions of the jet boundary.

Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-30543*# Southwest Center for Advanced Studies, Dallas, Tex.

STUDY OF COSMIC RAY INTENSITY MEASURED BY MARINER II AND BY GROUND NEUTRON MONITORS DURING THE FORBUSH DECREASE OF SEPTEMBER 30, 1962

U. R. Rao [1965] 12 p refs Submitted for Publication

(Grant NsG-269-62)

(NASA-CR-64243) CFSTI: HC $1.00/MF $0.50 CSCL 20H

This note examines the data from various instruments on Mariner II and the data from ground neutron monitors during the Forbush decrease which occurred on September 30, 1962 (Day273). From the data, the following conclusions were drawn: (1) the changes in the ion chamber intensity measured in space during the Forbush decrease are very well correlated with the changes of neutron intensity at Deep River and at other neutron monitor stations. The neutron intensity at the ground, however, recovers much faster than the ion chamber intensity, indicating that the intensity of low energy cosmic rays has still not recovered to its pre-decreased value; (2) both the short term variations, such as Forbush decreases, and the long term variations have a similar spectrum of variation; and (3) the spectrum of variation during the Forbush decrease may be represented by $AE^{-0.45 \pm 0.04}$. The changes in cosmic ray intensity are very well correlated with the changes in solar wind velocity during the Forbush decrease. The effect is as though each individual burst of plasma cloud interacts with the interplanetary medium to produce a corresponding decrease in the cosmic ray intensity. N.E.A.

N65-30563*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

DYNAMICAL THEORY OF THE SOLAR WIND

E. N. Parker [1965] 96 p refs

(Grant NsG-96-60)

(NASA-CR-64266; EFINS-65-57) CFSTI: HC $3.00/MF $0.75 CSCL 20H

The basic theoretical dynamical properties of an atmosphere with an extended temperature strongly bound by gravity are reviewed, and the dynamic equilibrium theory is used to analyze the origin of solar corpuscular radiation. It is shown that a solar corona of filamentary structure would not be seen at the orbit of Earth, and that viscosity is unimportant for the expansion of an atmosphere. The termination of solar wind, presumably between $10–10^3$ a.u., is discussed briefly with emphasis on resonant scattering from neutral hydrogen of interplanetary origin. G.G.

N65-30620# Royal Astronomical Society, London (England).

ABSOLUTE MEASURES OF STELLAR RADIATION, II

R. V. Willstrop 1965 60 p refs Sponsored in Part by Dept. of Sci. and Ind. Res. *Its* Mem. Vol. 69, Pt. 3

A photoelectric spectrum-scanning photometer has been built at the Cambridge Observatories. This has been used, first in preliminary trials at the prime focus (f/4-5) of the Cambridge 36-in. reflector, for which it was specifically designed, and then at the Newtonian focus (f/4-85) of the Radcliffe 74-in. reflector. All the results quoted in this paper are from measurements made at Pretoria. The spectra of 215 stars, with spectral types from O_5 to M_4 and luminosity classes 1 to V, have been scanned with 50Å resolution from 3300 Å to 6900 Å. The intensities observed have been corrected for atmospheric abosrption, etc., and normalized to give the absolute intensity, in c.g.s. units, received outside the Earth's atmosphere from a star of the same spectral type and apparent magnitude V = 0·00. The normalization depends on the results of earlier work by the writer (1), which covered the B and V spectral regions. The results published here cover the range 4000 Å to 6500 Å. Author

N65-30634# Washington Univ., St. Louis, Mo. Cosmic Ray Group.

PRIMARY COSMIC RADIATION Final Report, 3 Jan. 1962–3 Jan. 1964

M. W. Friedlander and J. Klarman [1965] 9 p

(Contract DA-ORD-(D)-31-124-G256)

(AROD-2774-6; AD-464740)

Fragmentation of heavy cosmic ray nuclei; balloon flights concentrating on tracks of alpha particles; multiple scattering; spark chambers; and improvements in an emulsion technique are considered. Emulsions interleaved with polyethylene and teflon sheets were flown, and tracks of heavy cosmic ray particles were found. It is reported that several hundred interactions were located in the plastics, and fragmentation parameters relating to collisions were calculated. Flux values of various tracks obtained in balloon flights, and geomagnetic cutoff energies were among the data considered. Glass backed emulsions and a low temperature isothermal development procedure are reported which yield low distortion values on high energy measurements. An apparatus is discussed which uses spark chambers to indicate the entry point into emulsions of particles which are of interest. The construction of a photodensitometer for measuring the tracks of heavy particles is also reported. C.T.C.

N65-30724*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE SOLAR WIND VELOCITY AND ITS CORRELATION WITH GEOMAGNETIC, SOLAR AND COSMIC RAY ACTIVITY

Conway W. Snyder, M. Neugebauer, and U. R. Rao [1963] 4 p Presented at Intern. Conf. on Cosmic Rays, Jaipur, India Prepared jointly with Southwest Center for Advanced Studies

(NsG-269-62)

(NASA-CR-64091) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The correlation of plasma velocity measured by Mariner II with various indices of solar and terrestrial activity during more than 4.5 solar rotations during the period August to December 1962 is discussed. The daily mean and the six-hourly mean plasma bulk velocities are derived from about 40 000 spectra received from the plasma probe which consisted of a single electrostatic spectrometer pointing within 0.1 degrees of the center of the sun. Plots of the daily mean plasma velocity, the planetary indices K_p, cosmic ray activity, the six-hourly mean plasma velocity and K_p for three selected periods are given. The tabulated data indicate that there was always a measurably large plasma flow from the direction of the sun; that the plasma velocity varied from day to day; that plasma velocity is not correlated with the cosmic-ray diurnal amplitude or time of maximum or with overall solar activity; that plasma velocity is very strongly correlated with K_p the relationship of which is represented by an equation; and that the plasma velocity showed a very strong 27-day recurrence tendency and a close association with M-region storms indicating that M-regions are emitters of high velocity plasma. L.S.

N65-30837*# RAND Corp., Santa Monica, Calif.
THE INVARIANT IMBEDDING EQUATION FOR THE DISSIPATION FUNCTION OF A HOMOGENEOUS FINITE SLAB
R. E. Bellman, H. H. Kagiwada, R. E. Kalaba, and S. Ueno Jul. 1965 11 p refs
(Contract NASr-21(07))
(NASA-CR-64336; RM-4651-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A differential-integral equation is derived for the dissipation function in a situation where parallel rays of radiation are incident on a finite homogeneous slab which absorbs and scatters isotropically. A conservation relationship connecting the reflection, transmission, and dissipation functions is also derived. These relations are useful for both analytic and computational purposes. R.N.A.

N65-30872# Uppsala Univ. (Sweden). Cosmic Ray Group.
COSMIC RAY INTENSITY VARIATIONS DURING 1964 Technical Note No. 1
A. E. Sandström, E. Dyring, L. Ekström, S. Lindgren, B. Sporre et al 30 Mar. 1965 28 p
(Grant AF-EOAR-64-64)
(AFCRL-65-349; AD-617121)

The recorders have continued as during the last years by one neutron monitor, two cubical telescopes and six inclined telescopes in Uppsala and Kiruna. Tables and figures give a detailed account of diurnal and semidiurnal variations during 1964. Only one decrease is illustrated in a one-hour diagram. Author

N65-30903# Uppsala Univ. (Sweden). Inst. of Physics.
A STUDY OF ATMOSPHERIC EFFECTS ON COSMIC RAY RECORDS FROM PLASTIC SCINTILLATION MONITORS AT UPPSALA Scientific Report No. 2
L. Ekström 15 Apr. 1965 16 p
(Grant AF-EOAR-64-64)

Atmospheric effects on cosmic ray records from new plastic scintillation monitors have been studied according to modified Duperier and Dorman models. Pressure coefficients are found for the vertical as well as the inclined directions. The two models are investigated partly by an "ordinary" or "direct" method and partly by a "successive difference" method. A significant difference between the results from the two methods is found specially in the Dorman case. The serial correlation of the residuals has been tested with a statistic d. This test seems to point out that the "difference" method is more favorable and gives more reliable results from a statistical point of view. Author

N65-31005# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF THE APPLICATION OF PERCEPTRONS FOR THE PREDICTION OF LARGE SOLAR FLARES Prep II Monthly Letter Report No. 2, Jun. 1964
A. E. Murray 15 Jul. 1964 6 p
(VS-1945-X)

Work on the improved use of adaptive classification techniques for predicting solar flares and the development of active solar regions resulted in computer programs for calculating the means and variances of forecast variables as type IV flare indicators, and for the covariance of property pairs. The new mean, variance, and covariance programs contain the value of a daily sequence of similar measures and identify the measure in time. Approximately seven new quiet regions were added to the total sample of region passes for future experiments. G.G.

N65-31047*# Geophysics Corp. of America, Bedford, Mass.
PHYSICS OF PLANETARY ATMOSPHERES II: THE FLUORESCENCE OF SOLAR IONIZING RADIATION
A. Dalgarno and M. B. Mc Elroy May 1965 25 p refs
(Contract NASw-1283)
(NASA-CR-64424; GCA-TR-65-15-N) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The mid-day dayglow intensities arising from the fluorescence of solar ionizing radiation are calculated. The predicted overhead intensities above 120 km of the $O^+(^2P\text{-}^2D)$ lines at λλ7319–7330Å, the Meinel band system of N_2^+, the first negative system of N_2^+, the first negative system of O_2^+, the Hopfield emission system of O_2^+ and the second negative system of O_2^+ are, respectively, 500 R–1 kR, 9 kR, 600 R, 2 kR, 600 R and 400 R. Author

N65-31055*# Space Technology Labs., Inc., Redondo Beach, Calif.
PITCH ANGLE DISTRIBUTION AND MIRROR POINT DENSITIES IN THE OUTER RADIATION ZONE
T. A. Farley and N. L. Sanders Mar. 1962 31 p refs
(NASA-CR-64279) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A method is presented for the calculation of the equatorial pitch angle distribution (unidirectional intensity distribution) of trapped radiation from the count rate of an omnidirectional detector along a line of force. An expression is derived for the calculation of the mirror point density from the equatorial pitch angle distribution. The method is applied to data obtained from the Space Technology Laboratories scintillation counter and the University of Chicago proportional counter on the Explorer VI satellite. The results from the scintillation counter show a relative absence of electrons with pitch angles of 90° during quiet periods, a sharp increase in such particles shortly after a sudden commencement magnetic storm, and restoration of the pre-storm distribution at a higher intensity level after the storm. The results from the proportional counter are qualitatively similar with the exception of the apparent deficiency of 90° pitch angles during quiet periods, which does not appear. Author

N65-31215# Joint Publications Research Service, Washington, D. C.
NEAR-EARTH AND INTERPLANETARY PLASMA
D. I. Gringauz 19 Aug. 1965 12 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 5, May 1965 p 60–65
(JPRS-31615; TT-65-32110) CFSTI: $1.00

The theoretical and experimental investigations of near earth and interplanetary plasmas prior to the first satellite launchings, and the results of satellite and space rocket studies were surveyed. Some of the early theories and models of interplanetary plasma are discussed, and experimental results of near earth plasma investigations are included. The experiments indicate that the earth's ionosphere is ten times greater and the concentration of interplanetary plasma one hundred times less than had been supposed prior to the launching of the first space probes. E.W.

N65-31216# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
VALIDITY OF THE EDDINGTON APPROXIMATION TO THE RADIATIVE TRANSPORT EQUATION
J. L. Kulander Jul. 1965 24 p refs
(R65SD14)

The mean intensity of the radiation field, J_ν, is calculated assuming various LTE and non-LTE source functions using both the exact expressions and the Eddington approximation, for plane-parallel geometries. The results are used to determine

the maximum error encountered in using the Eddington approximation and the optical depth where the maximum error occurs in layers of various thicknesses. It is found that by assuming the Krook modification of the surface boundary conditions the maximum error to be encountered is generally less than 10–15% as long as the total optical thickness of the layer is greater than or approximately unity. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-30349# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
DATA ANALYSIS OF ECHO I, II AND THE MOON. VOLUME I: AN ANALYSIS OF ECHO II, REFLECTED SIGNALS AT 2 KMC/SEC
S. L. Zolnay Griffiss AFB, N. Y., RADC, May 1965 45 p refs
(Contract AF 30(602)-2166)
(RADC-TR-65-67, Vol. 1: AD-617536)

This report discusses the results of the data analysis performed on the data obtained from the Echo satellites and the moon. This volume discusses the general signal characteristics and the accuracy of the system used to collect the data. Author

N65-30451*# Space Technology Labs., Inc., Redondo Beach, Calif.
EARTH SATELLITE ORBIT COMPUTATIONS. PART I: DILIBERTO THEORY Final Report
27 Aug. 1962 94 p refs
(Contract NAS5-1246)
(NASA-CR-64175; STL-8619-6004-TU-000, Pt. I) CFSTI: HC $3.00/MF $0.75 CSCL 22C

The Diliberto general perturbation method based on the theory of periodic surfaces has been applied in a new and more suitable coordinate system. As a result, analysis and results have been considerably simplified. An analytic treatment of the time-angle relationship for this coordinate system has been developed. By introducing a further change of variables, low eccentricity singularities have been eliminated. The special cases of polar and equatorial orbits have been examined, and convergence of the method demonstrated in the latter case. Both the basic and the low eccentricity method have been tested numerically. Author

N65-30452*# Space Technology Labs., Inc., Redondo Beach, Calif.
EARTH SATELLITE ORBIT COMPUTATIONS. PART II: ATMOSPHERIC EFFECTS Final Report
O. K. Smith, ed. 27 Aug. 1962 60 p refs
(Contract NAS5-1246)
(NASA-CR-64173; STL-8619-6004-TU-000, Pt. II) CSCL 22C

After a discussion of some currently available model atmospheres, errors in orbital prediction and the optimum selection of smoothing interval are examined. Studies of analytic methods for computing orbits of satellites subject to drag forces are also reported. Author

N65-30471*# IIIT Research Inst., Chicago, Ill.
SPATIAL DISTRIBUTION OF THE KNOWN ASTEROIDS
F. Narin 1 Apr. 1965 28 p refs *Its* Rept.-T-9
(Contract NASr-65(06))
(NASA-CR-64094) CFSTI: HC $2.00/MF $0.50 CSCL 03A

The question of the distribution of asteroids in the solar system has significance in planning space flights to either avoid asteroid encounters or to maximize asteroid encounters. The orbital elements of the asteroids have been studied extensively; many regularities have been found in these orbital elements. This report differs from much of the previous work in that here the actual positions of the asteroids at specific times are analyzed, rather than their orbital elements. Author

N65-30476*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ENGINEERING IN SPACE EXPLORATION, SEMINAR PROCEEDINGS
1 Jun. 1965 55 p ref Seminar held at Stanford Univ., Calif., 1 May–5 Jun. 1963
(Contract NAS7-100)
(NASA-CR-64081) CFSTI: HC $3.00/MF $0.50 CSCL 22A

In this lecture series, an introduction ot systems engineering as applied to planetary mission design is given, the various elements of the system are described, and related problems are discussed. Definitions and examples are used to explain systems design and systems design studies, and the application of these study activities to the Ranger and Surveyor program is described. The technology of systems analysis is discussed, and it is shown how such analyses contribute to the design and flight of lunar and planetary spacecraft. Definitions and analogies are used to describe space flight operations. The relationship existing between mission objectives, resources (money, manpower, facilities), and boundary conditions (schedule, performance, reliability) is examined, and the responsibility of engineering personnel in preventing failures is pointed out. C.T.C.

N65-30481*# IIT Research Inst., Chicago, Ill.
A SURVEY OF COMET MISSIONS
D. L. Roberts May 1965 96 p refs
(Contract NASr-65(06))
(NASA-CR-64093; M-7) CFSTI: HC $3.00/MF $0.75 CSCL 22A

Ways in which cometary missions can complement and significantly add to the present understanding of comets are discussed, and mission profiles for cometary intercept missions are outlined. Consideration has also been given to the importance of further observations of comets from the earth, laboratory study of simulated cometary phenomena, and the use of man-made artificial comets launched into orbit and observed from the earth. The areas of present understanding of the physics of comets are reviewed, and methods of investigating the major problem areas through a combination of earth-based study and comet missions are discussed. C.T.C.

N65-30565*# National Aeronautics and Space Administration, Washington, D. C.
MARINER IV PRESS CONFERENCE
William H. Pickering et al 15 Jul. 1965 55 p
Available from the Scientific and Technical Information Division
CSCL 22A

A press conference is presented on the Mars photographic experiment of Mariner IV and on the findings of its various scientific data gathering instruments which include the magnetometer, solar plasma probe, cosmic ray telescope, ionization chamber, trapped radiation detector, and cosmic dust detector. R.N.A.

N65-30650*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A METHOD OF IMPLEMENTING CUTOFF CONDITIONS FOR SATURN V LUNAR MISSIONS OUT OF EARTH PARKING ORBIT ASSUMING A CONTINUOUS GROUND LAUNCH WINDOW

F. Don Cooper 25 May 1965 31 p refs

(NASA-TM-X-53268) CFSTI: HC $2.00/MF $0.50 CSCL 22A

A method of implementing Saturn V lunar missions from an earth parking orbit is presented. The ground launch window is assumed continuous over a four and one-half hour period. The iterative guidance scheme combined with a set of auxiliary equations that define suitable S-IVB cutoff conditions, is the approach taken. The four inputs to the equations that define cutoff conditions are represented as simple third-degree polynomials as a function of ignition time. Errors at lunar arrival caused by the separate and combined effects of the guidance equations, cutoff equations and input representations are shown. Vehicle performance variations and parking orbit injection errors are included as perturbations. Appendix I explains how aim vectors were computed for the cutoff equations. Appendix II presents all guidance equations and related implementation procedures. Appendix III gives the derivation of the auxiliary cutoff equations. Author

N65-30651*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ORBITAL PARAMETERS FOR THE OGO-E GEO-CORONAL HYDROGEN EXPERIMENT

Stephen J. Paddack Jul. 1965 34 p refs

(NASA-TM-X-55276; X-643-65-294) CFSTI: HC $2.00/MF $0.50 CSCL 22C

This document presents and applies methods for obtaining certain necessary orbital and spacecraft parameters for meaningful data analysis of the geo-coronal hydrogen measurement experiment (Experiment No. 22) on the fifth in Orbiting Geophysical Observatory Series, namely the OGO-E. Techniques are presented for determining as a function of time: 1) orbit inclination with respect to the ecliptic plane, 2) the angle between the orbit's angular momentum vector and the sun's position vector, 3) the half angular dimension of the earth viewed from the satellite, 4) the solar array angle and, 5) the angle between the projection of the sun on the x-y plane of the experiment's coordinate system and the x-axis of that system. The calculations were made using a numerical integration general purpose interplanetary trajectory program (ITEM). Consequently, the changes in the orbit due to perturbations are reflected in the calculations of the quantities mentioned above. The results of computer runs are presented in this document. Author

N65-30658# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SOME MORPHOMETRIC PROPERTIES OF THE LUNAR SURFACE—A PRELIMINARY INVESTIGATION FROM LUNAR AERONAUTICAL CHARTS

Richard J. Pike 21 Aug. 1964 120 p refs *Its* Internal Res. No. 86-141

(CAL-VS-1985-C-1; AD-616899)

A numerically-expressed and relatively objective system of topographic description which was used to delimit homogeneous 'terrain regions' in Central Europe is applied to the lunar surface, hoping to delimit reasonably homogeneous topographic regions, and then use the numerical descriptions of these regions to infer, statistically, the configuration of the lunar surface at a scale far below that from which the basic data were taken. The principal objective is to be a prediction of surface roughness, an estimation of the configuration of the microterrain upon which projected manned vehicles would have to land or over which they would maneuver. TAB

N65-30699*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

ON THE USE OF APPROXIMATE ANALYTICAL SOLUTIONS IN SOLVING OPTIMUM TRAJECTORY PROBLEMS

Donald J. Jezewski Washington, NASA, Aug. 1965 16 p refs

(NASA-TN-D-2961) CFSTI: HC $1.00/MF $0.50 CSCL 22C

A method is presented for obtaining numerical solutions of nonlinear, optimum trajectory problems by using an approximate analytical solution in a convergence process. Convergence to specified terminal conditions is based on an analytic solution representing a reasonable approximation to the nonlinear system of equations. A numerical example of three-dimensional, time-optimal trajectory solutions in vacuum with a constant thrust is used to illustrate the technique. A gravitational force varying as the inverse square of the radius is considered. The approximate analytic solution is obtained from a system of quasi-optimum transcendental equations. This analytic solution is used to obtain the initial and succeeding approximations to the initial values of the Lagrange multipliers. Generally, only a few iterations are required to obtain solutions which satisfy specified boundary conditions. Author

N65-30726*# Geophysics Corp. of America, Bedford, Mass.

PLANETARY METEOROLOGY

George Ohring, Wen Tang, and Joseph Mariano Washington, NASA, Aug. 1965 91 p refs

(Contract NASw-975)

(NASA-CR-280) CFSTI: HC $3.00/MF $0.75 CSCL 03B

Inferences concerning atmospheric circulation features on Mars are made from analysis and interpretation of some observed Martian cloud systems and from application of meteorological theory to the Martian atmosphere. The trajectories of several cloud systems and the use of two different theoretical criteria suggest the presence of a wave type circulation regime on Mars. Cloud observations also suggest the presence of subtropical high pressure centers and upper level meridional flow and frontal phenomena at equatorial latitudes. Radiative equilibrium temperatures are computed for the surface and atmosphere of Venus. In the model used for the computations, it is assumed that the atmosphere and cloud cover are both gray in the infrared. The effect on the computed surface temperature of different values of infrared emissivity, height, and thickness of the cloud layer, and infrared opacity of the gaseous absorbers, is evaluated. Equations are derived for the computation of the radiative equilibrium temperature profile in the nongray atmosphere above the Jovian cloud layer, and circulation phenomena in the Jovian atmosphere is examined. E.E.B.

N65-30731*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LUMINOUS EFFICIENCY OF AN ARTIFICIAL METEOR AT 11.9 KILOMETERS PER SECOND

Wendell G. Ayers Washington, NASA, Aug. 1965 38 p refs

(NASA-TN-D-2931 CFSTI: HC $2.00/MF $0.50 CSCL 03B

A brief description is given of the Trailblazer IIb artificial meteoroid experiment, which consisted of reentering a 2.2-gram stainless-steel pellet into the earth's atmosphere at a reentry velocity of 11.9 km/sec. The methods of obtaining optical data and the data reduction procedures are outlined. The efficiency with which the kinetic energy of the artificial meteoroid was converted into effective radiant energy in the spectral sensitivity range of a panchromatic photographic emulsion was calculated from the observational data to be 1.2×10^{-2}. This value for the panchromatic luminous efficiency factor waas found to be in good agreement with values from a similar experiment. The effects of differences in the spectral

sensitivity of different detectors on measurements of the luminous efficiency factor are discussed, and methods of correlating results from different detectors are presented.
Author

N65-30746# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE DETECTION OF WATER IN THE ATMOSPHERE OF VENUS
A. Ye. Salomonovich 7 Apr. 1965 16 p refs Transl. into ENGLISH from Izv. Vssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 1, 1964 p 51–58
(FTD-TT-65-296/1+2; AD-614770)

The question of the nature of the cloud layer of Venus and the possibility of detecting water vapor in its atmosphere is considered in the light of new data concerning the radiation spectrum of the dark side of the planet.
Author

N65-30781# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
CHANGES IN BRIGHTNESS OF LUNAR DETAILS DEPENDENT ON THE AZIMUTH AND IN PROFILES OF LUNAR INDICATRICES
N. P. Barbashov Apr. 1965 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Komiss. po Fiz. Planyet, v. 3, 1961 p 31–40
(RSIC-398; AD-616538)

The dependency of the brightness of lunar objects on different azimuths of the incident and reflected rays is studied. The effect of the different azimuths is shown. The cited sectional indicatrices are for i = 30 degrees, i = 60 degree planes, passing through the incident ray and perpendicular to the plane of incidence. The conclusions drawn are that these studies further confirm the condition of similarity of microreliefs of the lunar surface, and that the changes in brightness of the lunar seas and continents are dependent on azimuth changes and comparable to the data for crushed tuff, the size of which ranges from 2–6 mm.
TAB

N65-30851# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESULTS OF THE NUMERICAL INTEGRATION OF THE EQUATIONS OF THE MOTION OF AN ARTIFICIAL EARTH SATELLITE
A. Y. Yegorova 19 May 1965 13 p Transl. into ENGLISH from Buyll. Akad. Nauk SSSR., Inst. Teor. Astron. (Leningrad)
(FTD-TT-65-57/1+2; AD-617666)

A numerical integration of the equations of the disturbed motion of a satellite in the field of gravitation of the earth, moon, and sun is presented. It was assumed that the earth has the form of an equalized ellipsoid of rotation. The results of the computations are given in graphical form and show the value for the disturbances of the elements at the moment of the satellite's passing through the perigee. It is observed that the basic part of the disturbances of longitude of perigee is constituted by the disturbance from the flattening of the earth.
E.E.B.

N65-30883# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
AN INTRODUCTION TO THE GEOLOGY OF THE MOON Special Report No. 23
Luciano B. Ronca May 1965 37 p refs
(AFCRL-65-357; AD-617721)

An introduction to the study of the moon is presented from a geological point of view. The most important theories on lunar features are presented and discussed, and new interpretations are proposed. Lunar physiography, stratigraphy and tectonics are described. The most important physiographic features are craters, terrae, maria, rilles, wrinkle ridges, rays, halos, mountain ranges, and alpine valleys. From the physiography it is possible to speculate on the geologic processes acting on the moon. These are "space weathering", meteoritic impact, volcanism, ballistic transportation and sedimentation, electrostatic transportation, and tectonism. The stratigraphy has been determined by applying the law of superposition. The column consists of the Pre-Imbrian, Imbrian, Procellarian, Eratosthenian, and Copernican Systems. The future of lunar exploration is discussed.
Author

N65-30971# Manchester Univ., Macclesfield (England). Nuffield Radio Astronomy Labs.
THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO STARS BY THE LUNAR OCCULTATION TECHNIQUE. OBSERVATIONS OF GALACTIC AND EXTRAGALACTIC EMISSION AT 408 Mc/s Progress Report, Oct.–Dec. 1964
Conrad H. Slater, C. G. T. Haslam, and M. J. S. Quigley [1964] 11 p
(Contract N62558-3928)
(PR-1; AD-616927)

From the times of immersion and emersion a preliminary position for MSH 13-011 accurate to within two or three seconds of arc has been derived; the 1950.0 coordinates are as follows: Right ascension $13^h35^m31.6^s$; declination $-06°\ 11^m55^s$. These coordinates have now been used by the prediction service to make more precise predictions of occultations of this source in 1965. A multiple frequency primary feed for the Mark I telescope is also reported, and a table of lunar parallax corrections is presented. A data logger designed to sample six signal channels with provision for a plug-in program to control the layout of the printed results is described. Each signal channel comprises a linear integrator which is synchronized to the logger. The accuracy of reading each channel is 0.1% with a maximum long term drift of ±0.2%. A block diagram of the equipment is included.
E.E.B.

N65-30994 Joint Publications Research Service, Washington, D. C.
PRELIMINARY RESULTS ON THE OBSERVATION OF EPHEMERIS TIME BY PHOTOGRAPHIC DETERMINATION OF THE MOON'S POSITION
Wan Lai, Wen-ching Chin, Hui-ch'eng Tsou, and FU-Min Yang *In its* Transl. on Communist China's Sci. and Technol. No. 202 9 Aug. 1965 p 53–57 refs Transl. into ENGLISH from K'o Ksueh T'ung Pao (Peking), no. 5, May 1965 p 435–437 (See N65-30991 19-34) CFSTI: $4.00

Dual rate cameras were used to observe the moon's position in order to establish the ephemeris time for the period September 1963 to March 1964. Results from 29 effective observations were compared with the corresponding universal time values through evaluation by formula $\Delta T_O = ET - UT$, where ET represents ephemeris time, and UT universal time. The T_O values relative to the center of the moon's shape are presented in a table. Some comparisons with ET time determinations from other countries' observatories are also shown.
G.G.

N65-31011*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
THREE COMPUTER PROGRAMS FOR N-BODY TRAJECTORIES AND INTERPLANETARY TRAJECTORIES
J. P. de Vries and T. Coffin Jan. 1964 88 p refs
(Contract NAS2-1706)
(NASA-CR-64357; R64SD7) CFSTI: HC $3.00/MF $0.75
CSCL 22C

This report contains complete input instructions, operating instructions and sample problems with computer output for three IBM-7094 Computer Programs. The Programs and their essential features are: Interplanetary Trajectory Program. This program determines the burnout velocity for a trajectory from Earth to any other planet or from any other planet to Earth N-Body Trajectory Program. This is an N-body program with fourth order Runge-Kutta integration with optional doubling and halving procedure and according to the Cowell or the Encke method. N-Body Program with Sensitivity Coefficients and Differential Correction. This is in purpose similar to the Interplanetary Trajectory Program, but a first estimate of the trajectory must be available from an external source. Full descriptions and analyses are presented for those features that distinguish Programs II and III from Program I. Author

N65-31020# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE SELENODETIC CONTROL SYSTEM OF THE ARMY MAP SERVICE
C. L. Goudas Feb. 1965 55 p refs *Its* Mathematical Note No. 390
(DI-82-0409)

Values of the coefficients J_{ij} and J'_{ij} of the expansion into surface harmonics of the lunar surface as presented by the Selenodetic Control System of the Army Map Service are derived. Data for the Marginal Zone are taken from the maps of Watts and Hayn and the measurements of Davidson and Brooks, and the far lunar side is assumed to be symmetrical to the near one. It is found that the present results agree with those derived from the data of Schrutka-Rechtenstamm and are close to the figures for a homogeneous Moon as far as the second zonal and sectorial terms are concerned. There is less agreement in the third surface harmonic and even less in the fourth. The results have little resemblance to those derived from Baldwin's data on exactly the same assumptions. It appears that at present the Selenodetic Control System of the Army Map Service should be rated as the best existing source, followed by the data of Schrutka-Rechtenstamm.
Author

N65-31060*# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
INVESTIGATION OF THE REACTION OF THE LUNAR SURFACE TO THE IMPACT OF A LUNAR PROBE Final Report
J. W. Gehring and R. L. Warnica Jun. 1963 62 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950299)
(NASA-CR-64363; TR63-215) CSCL 22A

This paper presents the results of an experimental research program to investigate the flash phenomena associated with high velocity impact. Specifically, the program was directed toward obtaining basic data about impact flash phenomena and using this data, together with that obtained from impacts on simulated lunar surfaces, to estimate the characteristics of the flash from the impact of a lunar probe on the moon. The program consisted of a parametric study of the variables associated with impacting a projectile against various targets, some of which simulate the lunar surface. The tests consisted of firing projectiles of varied mass, material, and velocity into a variety of target materials. Observations were made and quantitative data obtained for the magnitude of the luminosity of the impact flash, the duration of the flash, and the spectrum of emitted light. Also, high-speed optical pictures were made to determine the disposition of the impacting projectile and of the debris ejected from the resultant crater. Author

N65-31061*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE UTILITY OF UNMANNED PROBES IN LUNAR EXPLORATION
R. C. Speed, J. B. Adams, D. B. Nash 15 Jul. 1965 45 p (Contract NAS7-100)
(NASA-CR-64355; JPL-TM-33-291) CFSTI: HC $2.00/MF $0.50 CSCL 22A

The utility of unmanned lunar survey probes of the Ranger or Surveyor class in the post-Apollo scientific exploration program, Apollo Extension Systems (AEA), is defined. Missions, measurements, instruments, probe types, and probe requirements are evluated, and priorities are established. It is shown that the most important role for unmanned probes is one of widespread reconnaissance which attempts to define and amplify broad lunar problems and to delineate the most significant areas on the Moon for subsequent, detailed investigations by manned vehicles. Author

N65-31187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COSMOLOGY WITHOUT GENERAL RELATIVITY
E. R. Harrison Jul. 1965 16 p refs
(NASA-TM-X-55275; X-641-65-287) CFSTI: HC $1.00/MF $0.50 CSCL 03C

An isolated cell, infinitesimally small and embedded in flat space, forms the basis of a microcosmic model of the universe. An internal observer perceives an expanding unbounded universe and applies the same theoretical concepts commonly used in macrocosmic models. He is also free to work within the framework of special relativity theory, and from the first law of thermodynamics and the equations of hydrodynamics is able to derive the cosmological equations without the aid of general relativity and without making any approximations. The application of the cosmological principle to a universe containing a uniform perfect fluid accounts for the complete equivalence of the microcosmic model with the usual macrocosmic models. The microcosmic model avoids however the ambiguous nature of the gravitational field in a uniform unbounded fluid and is also not limited in its treatment to a pressure-free universe. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-30214 Library of Congress, Washington, D. C. Aerospace Technology Div.
NEW DESIGN PRINCIPLES IN SOVIET LAUNCH-VEHICLE DEVELOPMENT
A. Dolgich *In its* Foreign Sci. Bull., Vol. 1, No. 7 Jul. 1965 p 31–33 refs (See N65-30207 19-34)

An analysis is made of possible current trends in Soviet launch-vehicle development, with particular emphasis being placed on recent official Soviet releases describing launch-vehicle tests. It is conjectured that Soviet launch vehicles may now have a configuration embodying staging in parallel and employing liquid propellants which are storable, perhaps with the aid of a novel refrigeration system. Author

N65-30535# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.
WASP ROCKET ADVANCED DEVELOPMENT PROGRAM
Quarterly Report, 1 Feb.–15 Mar. 1965
[1965] 20 p
(Contract DA-01-021-AMC-11835(Z))
(Rept.-1919-1; AD-465890)

This report programs and schedules the design and testing of propulsion and ignition systems operating in a spin environment, and the assessment of dynamic stability. Author

N65-30552# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THERMAL DESIGN AND PERFORMANCE OF AN EARTH SATELLITE LAUNCHED SHORTLY AFTER A HIGH-ALTITUDE NUCLEAR EXPLOSION
Kenneth F. Read Aug. 1964 85 p refs
(Contract NOw-62-0604-c)
(CM-1046; AD-458824)

This report presents the development of a new thermal analysis technique that offers the singular advantage of providing a rapid first approximation to the thermal design of near earth satellites. In particular, the application of this method of analysis is demonstrated by showing how this technique was used in the thermal design of a satellite that was launched shortly after the first high-altitude nuclear explosion. Author

N65-30564*# National Aeronautics and Space Administration, Washington, D. C.
TIROS: THE SYSTEM AND ITS EVOLUTION
[1965] 31 p
(NASA-TM-X-56696) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Problems and factors which affected the development of the TIROS Project are reviewed. The evolution and history, design, and operational information concerning the TIROS system are discussed. R.N.A.

N65-30685*# National Aeronautics and Space Administration, Washington, D. C.
PEGASUS
[1965] 8 p
(NASA Facts, Vol. II, No. 15) GPO: $0.10 CSCL 22B

General information is presented on the Pegasus meteoroid detection satellite. Launch and orbital information and meteoroid studies are discussed, and the center and adapter sections of the satellite and its Saturn I launch vehicle are described. R.N.A.

N65-30931# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate.
THE DELTA T METEOROLOGICAL ROCKET PAYLOAD
John G. Mc Coy and Claude L. Tate Jun. 1965 12 p refs
(ERDA-319; AD-467018)

A newly designed meteorological rocket payload for use with a 10-mil bead thermistor temperature sensor is described. Temperature measuring accuracy has been increased through greater instrument stability and reduced sensing current. A rechargeable power supply provides for increased data transmission time and greater operational flexibility. Author

N65-30950*# General Dynamics/Astronautics, San Diego, Calif.
COMPILATION OF ATLAS E AND F SERIES VEHICLE FLIGHT ENVIRONMENTAL VIBRATION DATA, PART 1
Technical Report, Oct. 1960–Apr. 1964
R. L. Batten 1 Mar. 1965 515 p
(Contract NASI-4471)
(NASA-CR-64400; GD/A-DDE65-016) CFSTI: HC $8.15/MF $2.50 CSCL 22D

A compilation of all evaluated acoustic and vibration data from Atlas E and F series vehicle flights is presented, together with a description of the basic vehicle configuration. Vibration measurements are reported in waveforms, root mean square time histories, and power spectral density plots. Acoustic measurements were reduced to overall and octave sound band pressure level time histories. Instrumentation and reduction techniques are described, and an index system that cross references vehicle test number, vibration instrumentation, and measurement location information is included. G.G.

N65-31142*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THE EXPLORER XXIII MICROMETEOROID SATELLITE: DESCRIPTION AND PRELIMINARY RESULTS, NOVEMBER 6, 1964–FEBRUARY 15, 1965
Robert L. O'Neal ed. Washington, NASA, Aug. 1965 58 p refs
(NASA-TM-X-1123) CFSTI: HC $3.00/MF $0.50 CSCL 22B

The Explorer XXIII (1964 74A) is in orbit with a perigee of 250 nautical miles and an apogee of 529 nautical miles. It carries stainless-steel pressurized cells, impact detectors, capacitor detectors, cadmium sulfide cells, and test solar cells. The puncture rate in 0.002-inch stainless steel, derived on the basis of 25 punctures received to date, is 0.017 $ft^{-2}day^{-1}$. With 95-percent confidence, the average puncture rate in 0.002-inch stainless steel lies between 0.011 and 0.025 puncture $ft^{-2}day^{-1}$. The puncture rate in 0.001-inch stainless steel, derived on the basis of 24 punctures received to date, is 0.036 $ft^{-2}day^{-1}$. With 95-percent confidence, the average puncture rate in 0.001-inch stainless steel lies between 0.023 and 0.053 puncture $ft^{-2}day^{-1}$. No counts have been recorded by the capacitor-detector experiment through December 19, 1964. No measurable degradation of the test solar cells has been observed through December 19, 1964. Counting rates on the high-sensitivity impact-detection system (> 0.03 dyne-sec) have averaged lower than rates measured by the high-sensitivity system (> 0.5 dyne-sec) on Explorer XVI. Telemeter performance was satisfactory throughout this reporting period. Author

N65-31188*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SA-8 FLIGHT TEST DATA REPORT
H. J. Weichel 2 Aug. 1965 87 p
(NASA-TM-X-533308) CFSTI: HC $3.00/MF $0.75 CSCL 22D

This report is a presentation of certain flight mechanical data obtained from the SA-8 flight test. Digitized data are presented in graphical form. Also included are schematic drawings showing the instrument location on the vehicle. The intention of this report is to present the digitized data in an easy-to-read form for use by design and technical personnel. This report is to supplement the Saturn SA-8 Flight Evaluation Report and many other reports published by the various laboratories. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-30211 Library of Congress, Washington, D. C. Aerospace Technology Div.
METHODS FOR STUDYING THE DYNAMICS OF SPACE VEHICLES
L. Kacinskas *In its* Foreign Sci. Bull., Vol. 1, No. 7 Jul. 1965 p 14–18 refs (See N65-30207 19-34)

The dynamics of rigid bodies having cavities partially filled with liquid is studied by theoretical and experimental methods. Attention is concentrated on calculation of hydrodynamic coefficients. Numerical results obtained by theoretical and experimental methods are presented for bodies having cavities of various forms. A comparative analysis of theoretical and experimental results is made. Author

N65-30398*# National Bureau of Standards, Washington, D. C.
THE EFFECT OF ENVIRONMENT ON THE FATIGUE STRENGTHS OF FOUR SELECTED ALLOYS
T. R. Shives and J. A. Bennett Washington, NASA, Aug. 1965 24 p refs
(NASA Order R-14)
(NASA-CR-267) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Rotating beam fatigue tests of unnotched specimens of AISI 4340 steel, free-cutting brass, titanium alloy Ti-4Al-4Mn, and magnesium alloy AZ61A showed that the fatigue strength was lower in a moist environment than in a dry one. A coating of dodecyl alcohol was found to have a beneficial effect on the fatigue strength of the steel and magnesium alloy specimens, but did not completely eliminate the effect of humidity. The effect of environment on crack propagation was investigated with notched specimens of the magnesium alloy. An interesting tarnishing effect was observed on the fatigue portion of magnesium fracture surfaces. Author

N65-30409 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CRACKS SPREADING BETWEEN FLAT PLATES ON RECTILINEAR BOUNDARY OF GLUING
R. V. Gol'dstein and R. L. Salganik *In its* J. of Appl. Mech. and Tech. Phys. Feb. 1965 p 91–101 refs (See N65-30400 19-23)

A study of crack propagation along the rectilinear boundary of gluing between two elastic materials is reported. Presented are results of an analysis of a tension crack stretched by normal stresses under conditions of flat deformation; and propagation along a glued boundary into which a wedge of constant thickness is inserted, no external forces being applied. Demonstrated is the applicability of generalized assumptions concerning the autonomy of quasi-statically advancing cracks in the terminal region. S.C.W.

N65-30410 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUILIBRIUM CRACKS IN STRIP OF FINITE WIDTH
I. A. Markuzon *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 102–112 refs (See N65-30400 19-23)

The determination of the length of equilibrium cracking formed in a strip of finite width under the conditions of brittle fracture is considered. The size of equilibrium cracking is determined as a function of applied load. Also, the analogous problem of cracks having the form of round disks in plates of finite thickness is considered. It is shown that the behavior of cracks in the axisymmetric case is analogous to the behavior of straight cracks in finite strips. E.E.B.

N65-30426 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VARIATIONAL METHODS OF SOLUTION OF PROBLEMS OF DEFORMATION AND STABILITY OF PLATES AND SHELLS UNDER CONDITIONS OF CREEP
G. V. Ivanov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 247–251 refs (See N65-30400 19-23)

Variational methods for the solution of deformation and stability problems are discussed, and equations are derived for the determination of these values for a mildly sloping, circular, cylindrical panel. For plates and closed cylindrical shells the equations take the same form. This work is based on previous investigations of the deformation and stability of plates and shells under conditions of creep. E.E.B.

N65-30427 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE METHOD OF CALCULATION FOR CREEP BUCKLING
S. A. Shesterikov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 252–257 refs (See N65-30400 19-23)

A method for the approximation of creep buckling is described. The method is based on the assumption that for rods and thin-walled elements under the conditions of longitudinal compression the relation between stress and deformation can be replaced by analogous functions for bending moments and buckling. The equations for relationships are given and the significance of the approximations is discussed. E.E.B.

N65-30428 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TORSION OF PRISMATIC RODS OF IDEALLY PLASTIC MATERIAL WITH CALCULATION OF MICROSTRESSES
I. A. Berezhnoy and D. D. Ivlev *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 258–265 refs (See N65-30400 19-23)

The torsion of prismatic rods made of ideally plastic materials is considered and equations are given for the calculation of microstresses and microdeformations in square, rectangular, triangular, and polygonal rods. E.E.B.

N65-30429 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF STRAIGHT LINES OF DISCONTINUITY OF STRESSES FOR TRUE PLANE FLOW OF A RIGIDLY-PLASTIC BODY
O. D. Grigor'yev *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 266–268 refs (See N65-30400 19-23)

The relation between the condition of positiveness of dispersion power and the picture of the true plane flow near a straight line of break are considered. Also, the kinematic characteristics of straight line stress discontinuity are established. E.E.B.

N65-30430 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RELAXATION OF STRESSES IN THIN-WALLED PIPE
V. S. Namestnikov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 269–271 ref (See N65-30400 19-23)

During the investigation of relaxation of thin-walled pipe which was twisted and stretched simultaneously, it was assumed that elastic instantaneous components of deformation satisfy the condition of incompressibility. This assumption of incompressibility is examined. It is shown that consideration of compressibility improves the conformity of computed relaxation curves with the experimental curves if the latter are lower than the computed curves. The fact that computed relaxation curves

are above the experimental curves is caused by the influence of creep. E.E.B.

N65-30478*# Southern Research Inst., Birmingham, Ala.
AN EVALUATION OF THE EFFECT OF INSTALLED CALORIMETERS ON THE IMPINGING HEAT FLUX DENSITY Final Report
13 Jul. 1965 53 p refs
(Contract NAS8-5196)
(NASA-CR-64120) CFSTI: HC $3.00/MF $0.50 CSCL 20M

Lower surface temperature for a slug calorimeter has resulted in a higher input convective heat flux density, and the difference is considered greater than might be expected from temperature difference across the boundary layer. It is concluded that the heat transfer coefficients to two different calorimeters at different surface temperatures are not identical, some of the differences resulting from edge discontinuities. A major portion of the difference in measured convective heat flux densities was attributed to experimental inaccuracies in differences in insulation thicknesses and size and placement of calorimeter in a flight vehicle. M.W.R.

N65-30494# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
IMPACT PREDICTION OF THE AEROBEE AT WHITE SANDS MISSILE RANGE, NEW MEXICO
Ivan I. Layton and Marjorie Mc Lardie Hoidale Fort Monmouth, N. J., Army Electronics Command, Jun. 1965 25 p refs
(ECOM-5002; AD-466997)

Dispersion statistics are presented to show the capabilities and limitations of Aerobee Impact predictions made by Meteorological Support Division of the U. S. Army Electronics Research and Development Activity, White Sands Missile Range, New Mexico. Author

N65-30497# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
STATIC TESTS OF REINFORCED-CONCRETE DEEP BEAMS
G. E. Albritton Jun. 1965 120 p refs
(TR-1-676; AD-467023)

The objective of this study was to investigate the behavior of moderately deep, reinforced-concrete beams subjected to uniformly applied static loadings in order to verify design procedures for deep beams developed from previous tests. Thirty rectangular, reinforced-concrete deep beams simply supported on a span of 18 inches were tested under a uniformly applied static load. The composition of the beams was varied by addition of stirrups and various combinations of tensile and compressive steel. The concrete strength and span-to-depth ratio were held constant at f'_c = 4,050 psi and L/d = 4, respectively. All beams contained both tensile and compressive reinforcement. Measurements were made of longitudinal steel strains and concrete surface strains, deflections at top of beams, differential pressure of the loading system, and total reactions at the supports. Results verify that yield and ultimate strengths of a deep beam having a span-depth ratio = 4 can be predicted with reasonable accuracy by existing design methods. Author

N65-30533# Hexcel Products, Inc., Berkeley, Calif.
DEVELOPMENT AND EVALUATION OF A LIGHTWEIGHT ALUMINUM HONEYCOMB CASE Final Report
M. N. Bandak 30 Apr. 1965 75 p refs
(Contract DA-04-200-AMC-477(A))
(Rept.-6065; AD-466634)

A research and development program is presented for a sandwich structural design of a lightweight aluminum honeycomb case. The composite structure includes an inner shell to withstand a hydrostatic pressure up to 22 psi and an outer energy absorption envelope to protect a 185 pound payload from a drop height of 3 feet. The deceleration experienced by the payload during the impact is limited to 27 g's radially and 40 g's axially. Analytical and experimental investigations were made to achieve a high strength and minimum weight design. The final weight of the case is 22 pounds. The structure met design requirements for transportation vibration, temperature shock, salt spray, and sand and dust environment. R.N.A.

N65-30548*# Martin Co., Denver, Colo. Aerospace Div.
DETERMINATION OF ROCKET ENGINE NOISE DAMAGE TO COMMUNITY DWELLINGS NEAR LAUNCH SITES Final Report
R. W. Peverly Oct. 1964 74 p
(Contract NAS10-1108)
(NASA-CR-64283; CR-64-65, Vol. II) CFSTI: HC $3.00/MF $0.75 CSCL 13M

Tests were performed at the Florida and Denver launch sites to determine the noise damage to community dwellings caused by rocket engines. The fragility of windows to acoustic excitation was determined, and a content line for a motion picture was given. Data from the acoustic test laboratory are summarized, along with the news coverage of the Florida tests. R.W.H.

N65-30550# Columbia Univ., New York. Dept. of Civil Engineering Mechanics.
DETERMINATION OF THE COMPLEX SHEAR MODULUS OF A FILLED ELASTOMER FROM A VIBRATING SANDWICH BEAM
T. Nicholas and R. A. Heller Jun. 1965 94 p refs
(Contract Nonr-266(78))
(TR-30; AD-466040)

A technique for determining the complex shear modulus of a linear viscoelastic material from damped free vibrations of sandwich beams is presented. The sandwich beams consist of thin steel facings and cores of a filled elastomer. In such construction the facing experiences only extensional vibrations and the core only shear when the difference in stiffness between core and facing is large. The damping of the composite beam is much lower than the damping of the core material, thus allowing the use of a highly damped core. Author

N65-30581# Southeast Research Inst., San Antonio, Tex.
RESPONSE OF DEEP REINFORCED CONCRETE SLABS Technical Documentary Report, Jul. 1962–Apr. 1964
R. K. Gregory, R. C. De Hart, and W. J. Austin Feb. 1965 145 p refs
(Contract AF 29(601)-5385)
(WL-TDR-64-54; AD-613545)

The response of deep reinforced concrete slabs to uniformly distributed dynamic loads as high as 700 psi was measured and compared with the static behavior of companion slabs. Comparisons between theoretical and experimental results were made. Experience has shown that one of the major difficulties in predicting the static behavior of reinforced concrete slabs results from the varying friction between the slab and bearing plate. The pressure seals and seal devices presented the primary experimental difficulty and made it impossible to yield the strongest slabs. Author

N65-30585# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE DAMPING OF STIFFENED PLATE STRUCTURES

D. J. Mead [1964] 67 p refs Presented at the 2d Intern. Conf. on Acoustic Fatigue, Dayton, Ohio, Apr. 1964
(Contracts AF 61(052)-504; AF 61(052)-627)
(ISAV-MEMO-110)

This paper reviews some experimental work undertaken to measure the damping of both real aeroplane structures and also of models representing real structures. Consideration is given to the dependence of the damping on the nature of the mode of vibration and also on the thickness of the structural skin plating. Comparisons are made of the structural and acoustic damping. The effects of two different damping treatments are next investigated, viz. the unconstrained layer, and the sandwich plate configuration. Measured and calculated values of the damping are compared, and the effects of the treatments on the random response of the structure are considered. This leads to a consideration of the optimum design of damped structures of given weight. Experimental results are compared with theory. Author

N65-30587# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE DAMPING OF BEAM VIBRATION BY ROTATIONAL DAMPING AT THE SUPPORTS
D. J. Mead Dec. 1964 36 p refs
(Contract AF 61(052)-504)
(ISAV-121)

The effectiveness of an edge-constraint damping mechanism applied to a uniform beam is analyzed, assessed, and compared with the effectiveness of homogeneous damping layers applied throughout the length of the beam. In this damping mechanism, flexural vibration of the beam is damped by virtue of damping forces and couples exerted at its edges which are embedded in a viscoelastic material. A theory is developed for the linear flexural response of the uniform beam to uniform harmonic loading. Transverse displacements of the beam are prevented while rotation is opposed by the linear elastic and damping couples from the embedding material. Explicit expressions are derived for the amplitude of curvature at the center of the beam and from these it is shown that there exist optimum values of the constraint damping properties which will minimize the beam resonant response. Different optimum values are required to give the maximum effective flexural loss factors of the beam. The edge-constraint damping mechanism is more effective than thin homogeneous layers, but much less effective than thick layers. R.N.A.

N65-30593# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INFLUENCE OF BOUNDARY CONDITIONS DURING BUCKLING OF STRUCTURALLY-ORTHOTROPIC CYLINDRICAL SHELLS
V. G. Tret'iak [1965] 9 p ref Transl. into ENGLISH from Prik. Mekh. (Kiev), v. 1, no. 5, 1965 p 11-20

Analyzed were axi- and nonaxisymmetric buckling modes of structurally-orthotropic circular shells having different supports, and which were loaded by axial compression and uniform transverse pressure. The governing differential equations for different shell boundary conditions were formed, and the critical stresses determined by the roots of the transcendental equations. It was found that the influence of boundary conditions in axially stressed shells increases as the shell radius diminishes, the linear bending stiffness grows in the transverse sections, and the reduced thickness decreases in the longitudinal sections. Also developed were computations for specific boundary conditions during critical stresses by nonaxisymmetric buckling modes of a freely supported shell, a shell with clamped edges, and a shell with nonsymmetric boundary conditions. Author

N65-30600# ACF Industries, Inc., Albuquerque, N. Mex.
S-126 AXISYMMETRIC THIN SHELLS OF REVOLUTION
L. A. Ney 3 Aug. 1964 51 p refs
(Contract AT(29-1)1352)
(ACF-2)

A Fortran II language program (S-126) which solves a large class of stress and deflection problems of axisymmetric thin shells of revolution is presented. The two simultaneous equations which determine the rotation, deflection, moments, and stresses for the shells are shown, and terms are defined in symbolic form. A wide variety of loading and thermal conditions are permitted, and discontinuity of loading shape is permitted between regions. Horizontal and vertical loads, and moments can be input at region junctions. Step functions in pressure, thickness, and temperature are permitted if the given geometry is used. L.S.

N65-30613# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE STRESSED STATE OF SHELLS WEAKENED BY TWO CURVED HOLES
A. N. Guz' and K. I. Shnerenko [1965] 8 p refs Transl. into ENGLISH from Prik. Mekh. (Kiev), v. 1, no. 5, 1965 p 21-28

The stress state of a shell weakened by circular and noncircular holes is studied. To solve such a problem, an approximate method is used which is a combination of the Schwartz method and the method of perturbation of the boundary shape. Firstly, perturbation equations and method of solution are presented. Secondly, the stress state of a spherical shell weakened by circular and elliptical holes is considered. Finally, a numerical example of the problem is discussed. N.E.A.

N65-30614# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE STRESSED STATE AROUND CURVILINEAR REINFORCED HOLES IN SHELLS
A. N. Guz' and G. N. Savin [1965] 7 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 1, 1965 p 104-109

The stress state in shells around curvilinear holes reinforced by thin elastic rings (considered as material filaments) which resist extension, flexure and twist is investigated. N.E.A.

N65-30701# Louisiana State Univ., Baton Rouge.
A STUDY OF THE BEHAVIOR OF THICK CYLINDRICAL SHELLS Final Report, 4 Feb. 1963-4 Feb. 1964
Dale R. Carver, Edwin R. Chubbuck, and Robert L. Thoms Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1965 240 p refs
(Contract AF 29(601)-5836)
(WL-TR-64-64; AD-617064)

Three approaches to the problem of predicting stresses and displacements in thick cylindrical shells are described. Section I is an analysis of a ring or segment of an infinitely long thick cylindrical shell based upon the simplifying assumptions of the Winkler curved beam theory. Dynamic loading of thick rings is treated in Chapter 2 of Section I. Section II consists of a static analysis of the thick-walled circular cylinder (or ring) by the elasticity approach developed by N. I. Muskhelisvili. Shear and radial stresses on the inner boundary, outer boundary, or both boundaries constitute the loading. A rather complete theoretical development is followed by a computer program and instructions for its use. Section III presents an analysis of static stresses in axially loaded thick-walled cylinders with end caps. This axisymmetric elasticity problem is solved

by finite difference techniques and Southwell stress functions. Cylinders with one end closed by either a flat or a hemispherical cap are analyzed and an example worked for each case. Cylinders with both ends capped are analyzed in the final portion of the report. Author

N65-30702# California Univ., Berkeley. Inst. of Engineering Research.
DEFORMATION OF AN ELASTIC SPHERICAL WEDGE
R. M. Christensen Mar. 1965 25 p refs
(Contract Nonr-222(81))
(AM-65-2; AD-617137)

Analytical solutions are presented for two separate modes of deformation of an infinite elastic spherical wedge. In part, these solutions take the form of the stresses on the boundaries of the wedge caused by prescribed surface displacements. Full discussion is given to the means of utilizing these two solutions, along with corresponding tests, to determine the complete mechanical properties characterization of a linear isotropic viscoelastic solid. Author

N65-30717*# Aerojet-General Corp., Azusa, Calif.
THERMAL STRAIN ANALYSIS OF ADVANCED MANNED SPACECRAFT HEAT SHIELDS Final Report, 1 Sep. 1963–31 Aug. 1964
E. L. Wilson Sep. 1964 151 p *Its* Rept.-5654-02-F
(Contract NAS9-1986)
(NASA-CR-65062) CFSTI: HC $5.00/MF $1.00 CSCL 20K

Numerical methods and computer programs are presented for the analysis of heat shields. The finite element technique is used to determine stresses and displacements developed in composite axisymmetric solids of arbitrary geometry subjected to axisymmetric thermal or mechanical loads. This technique is then applied to the development of an automated computer program for the analysis of axisymmetric heat shields subjected to axisymmetric thermal and pressure loadings. Finally, the numerical technique is extended to the analysis of heat shields subjected to non-axisymmetric thermal loading. Several examples are presented to illustrate the application of the method and to demonstrate its validity. Fortran II card listings and descriptions of the use of the above programs are given in the appendices. Author

N65-30725*# Illinois Univ., Urbana.
GEOMETRICAL AND INERTIAL PROPERTIES OF A CLASS OF THIN SHELLS OF A GENERAL TYPE
Will J. Worley and Han-chung Wang Washington, NASA, Aug. 1965 71 p refs
(Grant NsG-434)
(NASA-CR-271) CFSTI: HC $3.00/MF $0.75 CSCL 20K

This second report is concerned with the evaluation of surface area, (or surface volumes when multiplied by the shell thickness), centroids of surface volumes or masses and moments of inertia for thin walled shells. The shells are defined by the first octant of

$$\left|\frac{x}{a}\right|^{\alpha} + \left|\frac{y}{b}\right|^{\beta} + \left|\frac{z}{c}\right|^{\gamma} = 1$$

where a, b, c, α, β, and γ are positive constants not necessarily integers. The above characteristics of thirty-two representative configurations are presented along with the first octant coordinate points necessary to represent these configurations. The computation, using the Gaussian quadrature method and performed on an IBM 7094 digital computer, consists of five place tables in floating point notation. Appendixes present the corresponding characteristics of solid bodies, in terms of gamma functions. The Fortran program is included. Author

N65-30734*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
BUCKLING OF ECCENTRICALLY STIFFENED ORTHOTROPIC CYLINDERS
David L. Block, Michael F. Card, and Martin M. Mikulas, Jr. Washington, NASA, Aug. 1965 33 p refs
(NASA-TN-D-2960) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A small-deflection theory for buckling of stiffened orthotropic cylinders which includes eccentricity (one-sided) effects in the stiffeners is derived from energy principles. Buckling solutions corresponding to classical simple-support boundary conditions are obtained for both orthotropic and isotropic stiffened cylinders subjected to any combination of axial and circumferential loading. Comparable solutions for stiffened flat plates are also given. Sample calculations of predicted compressive buckling loads obtained from the solutions are compared with existing solutions for ring-stiffened corrugated cylinders, ring-and-stringer-stiffened cylinders, and longitudinally (stringer) stiffened cylinders. The calculations demonstrate that eccentricity effects are large even with very large diameter cylinders of practical proportions and should be accounted for in any buckling analysis. Author

N65-30747# Princeton Univ., N. J. Dept. of Graphics and Engineering Drawing.
THE USE OF NOMOGRAPHY IN THE SOLUTION OF BEAM-COLUMN PROBLEMS
Morris Ojalvo 23 Mar. 1965 27 p refs *Its* Tech. Seminar Ser. Rept. No. 15
(AD-614596)

The pertinent set of conditions for a buckling column when the nature of the equilibrium changes may be expected to include the column length, shape of cross section, mechanical properties of the material, compressive load, and end moment. One of these is selected as an independent parameter while the others are taken as constant for the analysis. The equilibrium configuration is determined for several values of the parameter and sets of curves are obtained by plotting values of parameters against typical displacements or distortions of the deformed column. TAB

N65-30748# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
LOAD-CARRYING CAPACITIES FOR RECTANGULAR PLATES OF ANISOTROPIC MATERIALS
L. W. Hu Jan. 1965 28 p refs
(Grant AF-AFOSR-127-64)
(AFOSR-65-0314; AD-614575)

A complete solution to the load-carrying capacities of rectangular plates with anisotropy is obtained. The plates are simply supported and subjected to uniformly distributed load. The anisotropy is described by the modified v. Mises yield condition suggested by Hill. Also, a complete solution to the load-carrying capacities of isotropic plates is derived from the aforementioned solution as a special case. Author

N65-30750# Air Force Systems Command, Kirtland AFB, N. Mex. AF Weapons Lab.
SIMULATION OF AIR-BLAST-INDUCED GROUND MOTIONS (PHASE II) Technical Report, 1 Jul. 1964–1 Feb. 1965
Harry E. Auld, Gerald P. d'Arcy, and Gerald G. Leigh Apr. 1965 233 p refs
(AFWL-TR-65-26, Vol. I; AD-613674)

Results from the Phase II, Long-Duration High-Explosive Simulation Technique (LDHEST) experiment are presented. This experiment simulates the air-blast-induced ground motions from a large-yield nuclear weapon over a plan area 96 feet by 150 feet. A specially designed matrix of primacord was utilized to produce the desired explosion in a confined volume of air. An overburden, or mass of material, was placed over the explosion to provide a reaction force to shape the resulting wave pulse and to provide the required long durations. The experiment produced an air pressure pulse which had a peak overpressure of 312 psi, a time to one-half peak pressure of 18.2 msec, and a total duration of 170 msec. The shock front traveled at an average velocity of 5,120 ft/sec. On the basis of these results, recommendations are made for future simulation experiments. The measured earth free-field motions and stresses are compared with theoretical calculations, and the validity of the technique for simulating the desired nuclear environment is established. Author

N65-30763# Illinois Univ., Urbana. Dept. of Aeronautical and Astronautical Engineering.
FREE VIBRATION OF CONTINUOUS SKIN-STRINGER PANELS WITH NON-UNIFORM STRINGER SPACING AND PANEL THICKNESS Technical Report, Jun. 1963–Sep. 1964
Y. K. Lin, T. J. Mc Daniel, B. K. Donaldson, C. F. Vail, and W. J. Dwyer Wright-Patterson AFB, Ohio, AF Mater. Lab., 1965 58 p refs
(Contract AF 33(657)-11715)
(AFML-TR-64-347, Pt. 1; AD-614653)

The method of transfer matrices is employed to obtain the natural frequencies and mode shapes of an array of skin panels which are continuous over supporting stringers. The stringer spacing may be non-uniform and individual panels and stringers may vary from panel to panel. Donnell's equations for cylindrical shells are used in the analysis of curved panel systems. Numerical results are given for systems of three flat panels and of six flat panels. Author

N65-30767# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
A SEMI-INFINITE PLATE ON AN ELASTIC FOUNDATION
Donald E. Nevel Mar. 1965 18 p refs
(CRREL-RR-136; AD-616313)

The solution of the problem of a semi-infinite plate on an elastic foundation is presented. This problem occurs when a load is applied near the edge of a floating ice sheet. The equations are evaluated for an edge load, and the results given in graphical form for the following: (a) the maximum deflection which occurs at the edge under the load, (b) the moment which causes the initial cracking of the plate, (c) the distance from the edge that the circumferential crack will occur, and (d) the moment that causes the circumferential crack. The same method of solution can be applied to an infinite strip on an elastic foundation with any combination of simple, rigid, or free support at the edges. Author

N65-30819# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
BUILT-UP MEMBERS IN PLASTIC DESIGN. STRENGTH OF LONGITUDINALLY STIFFENED PLATE PANELS WITH LARGE b/t
Tsuneo Tsuiji Jun. 1965 66 p refs */ts* Fritz Eng. Lab. Rept. No. 248.14
(Contract NObs-90041)
(AD-616680)

An analytical investigation of the ultimate strength of longitudinally stiffened plate panels having large plate width to thickness ratios and subjected to combined axial and uniformly distributed lateral loads is presented. Of interest in this study are stiffened panels as used in ship bottom plating. The emphasis is placed on the effect of lateral loads, residual stresses and b/t ratio on the ultimate axial strength of the panels. The results were obtained numerically on a digital computer. The following effects on the ultimate axial load were established: (1) Lateral loads cause a significant reduction. (2) Compressive residual stresses in the plate have reducing influence. (3) A large postbuckling strength can be expected for panels with large plate width to thickness ratios. A comparison between the analytical and test results shows that the method of analysis developed in this study can predict the ultimate strength of stiffened panels with relatively good accuracy. Author

N65-30844*# Republic Aviation Corp., Farmingdale, N. Y. Engineering Div.
THE DETERMINATION OF THE NATURAL MODES OF VIBRATION OF THE SATURN SA-5 AND SA-8 VEHICLES Final Summary Report
S. Telles and C. J. Meissner 4 Jun. 1965 227 p refs
(Contract NAS8-2646)
(NASA-CR-64329; RAC-406-5; E-FR-57-48) CFSTI: HC $6.00/MF $1.25 CSCL 22D

This report contains the results of a vibration analysis performed upon the Saturn SA-5 and SA-8 vehicles. Twenty-seven independent modes were obtained for the SA-5 and twenty-six independent modes were obtained for the SA-8. The majority of the eigenvalues lie between .10 and 4.0. This corresponds to frequencies up to 10 cps. Author

N65-30859# Goodrich (B. F.) Co., Akron, Ohio. Aerospace and Defense Products Div.
PRESSURIZED BOW DOME OF A CABLE-REINFORCED RUBBER CONSTRUCTION FOR USE WITH AN/SQS-26 SONAR Monthly Summary Report, 30 Apr.–31 May 1965
W. J. Berus 31 May 1965 16 p
(Contract NObsr-89483)
(Rept.-27; AD-619068)

Progress on the pressurized sonar bow dome is reported. The aft port and starboard window sections were completed, X-rayed, and found to be acceptable for use. The four window sections were installed on the hydrostatic test fixture. Also, the three splices were fabricated and cured; however, the starboard and nose will require recure operations. The prototype test panel is successfully continuing on the 60 day, 40 psi stand test. E.E.B.

N65-30914# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LINCOLN LABORATORY ANALYSES OF PARABOLOIDAL SHELLS (LLAPS) User's Manual
J. W. Mar, F. Y. M. Wan, and E. Shea 16 Nov. 1964 52 p refs */ts* Lincoln Manual 60
(Contract AF 19(628)-500)
(ESD-TDR-64-578; AD-614818)

The primary design requirement of a high-performance antenna is that the reflecting surface remain paraboloidal. For an antenna housed in a radome, strength considerations play a minor design role. Therefore, the antenna must have adequate structural stiffness accompanied by minimum weight. The basic structural components of the antenna are paraboloidal panels, which, when joined together, form a surface of revolution. Such a structural configuration, if properly fabricated, can be considered as a shell. Shell structures derive many of their attractive features from their two-dimensional surface nature, which brings with it geometrical complications to the strain-deflection

relations and the equilibrium equations. Although the deflections of trusses, beams, and space frameworks are well understood, well documented, and easily obtained, this is not true for shells. In fact, shell behavior is currently the major topic of study in the structural mechanics field. The available solutions for even simple loadings of simple shells are of such a form that numerical results are not easily obtained. This user's manual will describe the capability, potentiality, and idiosyncrasies of the various LLAPS computer programs which are products of the above study. Author

N65-30933# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

DYNAMIC BEARING CAPACITY OF SOILS. INVESTIGATION OF A DIMENSIONLESS LOAD-DISPLACEMENT RELATION FOR RELATION FOR FOOTINGS ON CLAY

P. F. Hadala Jun. 1965 96 p refs Jointly Sponsored by DASA *Its* Rept.-4

(TR-3-599; AD-467081)

Nondimensional relations were previously developed to predict the maximum displacement and the time of its occurrence for dynamically loaded square footings on clay. Additional tests were conducted to determine if these prediction relations were dependent on the model scaling rules used. Dynamic footing tests in which the independent parameters were not related by any scaling rules were conducted on large soil specimens. The results of these tests essentially confirmed the original nondimensional relations. Load-pulse shape and duration were nearly constant. By using the original and new test data it was shown that each of the nondimensional relations can be expressed as a power function. It was also determined that the dynamic resistance parameter-displacement parameter relation can be approximated by converting static footing test data to the same nondimensional quantities and increasing the static resistance parameter by a factor of 1.5 to 1.9. A similar procedure can be used to approximate dynamic load-displacement curves from static plate-bearing test data. E.E.B.

N65-30943# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DEEP SUBMERGENCE STUDIES: AN ANNOTATED BIBLIOGRAPHY

George R. Evans and Charlie M. Pierce, ed. Jul. 1965 245 p refs

(LMSC-6-62-65-2/SRB-65-2)

An annotated bibliography containing 440 entries pertaining to deep submergence studies is presented. Considered are the following topics: *Structures*—vehicle design, analytical studies, and experimental studies; *Materials*—structural, and nonstructural; *Propulsion*—conventional, nuclear, and advanced and exotic concepts; *Stability and Control;* and *Environment*—internal, and external. A source and agency index is attached. G.G.

N65-30967# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

MATRIX ANALYSIS OF SHELL STRUCTURES

Stanley Klein Jun. 1964 174 p refs

(Contract AF 04(694)-427)

(ASRL-TR-121-12; AD-616907)

The methods of matrix structural analysis are applied to the solution of an arbitrary shell structure composed of shells of revolution under both symmetric and asymmetric loads. The Displacement Method is employed by assuming a power series displacement pattern along the meridian of a finite conical element. This plus a Fourier expansion in the circumferential angle results in an element stiffness matrix for the general k^{th} harmonic. Improvement of the element stiffness matrix using the Principle of Minimum Potential Energy is explored in detail. Comparisons with recent work in this area and with other methods of solution are presented. Numerical results for element matrices and for structural analyses are obtained for the symmetric situation, using an IBM 7094. These results indicate that the comparatively simple finite element displacement approach provides an effective method of handling the complicated shell problem. Author

N65-30982# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.

EXPLORATORY TESTS OF PROLATE SPHEROIDAL SHELLS UNDER EXTERNAL HYDROSTATIC PRESSURE

John J. Healey Jun. 1965 26 p refs

(DTMB-1868; AD-617190)

Hydrostatic tests were conducted on two machined aluminum prolate spheroidal shells to evaluate existing theory for predicting elastic buckling strength. The test results demonstrated that an elastic buckling pressure forty percent greater than predicted by available theory is possible for the geometry tested ($a/b = 3.0$, $h/R_0 = 0.03$). Due to these encouraging results, two titanium prolate spheroidal shells were designed for a collapse depth of 30,000 ft to explore the use of this configuration for deep-depth pressure hulls. The thicknesses of the shells were varied in order to increase structural efficiency. Two models were machined and tested to collapse under external hydrostatic pressure. The test results indicate that a titanium spheroidal shell designed for collapse at 30,000 ft with a yield strength of 110,000 psi, a length-to-diameter ratio of 2, and a thickness variation along its length would weigh approximately 76 percent of its displacement. The structural efficiency of the spherical shell and several other prolate spheroidal shells are compared for this material and collapse depth. Author

N65-31019# Etablissement Aeronautique de Toulouse (France).

REPORT ON FATIGUE TESTS CARRIED OUT IN FRANCE ON MATERIALS AND STRUCTURAL COMPONENTS IN 1963–1964

J. Auvinet [1964] 34 p

Fatigue life of aircraft materials and structural components was studied using light alloys and high strength steels. A pulsator and vibrophores were used for the steel tests; vibrophores and rotative bending machines were used for the alloys. Results of chemical analysis and mechanical tests are included. Surface finish treatment studies were made and the results are given in tabular form. Various assembly devices were considered, including influence of roll-working parameters under screw head on fatigue behavior and protection influence of titanium alloy bolts, and fatigue tests on mar-aging steel bolts. The sampling mode is illustrated and graphs are included for results of residual static strength, effect of surface finish and roll-working on fatigue life, crack propagation on shear panels, and tensile load. M.W.R.

N65-31027# College of Aeronautics, Cranfield (England).

THE STABILITY OF THE SHORT-PERIOD MOTION OF AN AIRFRAME HAVING NON-LINEAR AERODYNAMIC CHARACTERISTICS IN PITCH AND SUBJECT TO A STEP-FUNCTION ELEVATOR DEFLECTION

P. A. T. Christopher Jan. 1965 32 p refs

(CoA-AERO-178)

The stability of the differential equation

$$\frac{d^2x}{dt^2} + B(x)\frac{dx}{dt} + C(x) = Q, Q = 0, t < 0,$$

with B(x) and C(x) as anti-symmetric power series, is shown to be determined by the nature of the singularity at the steady-state value given by C(x) = Q, with certain additional restrictions on the initial and final value of x. Further, the character of the transient settling down motion is directly related to the nature of this singularity and, together with the stability, is accurately predicted by criteria derived. It is shown that the previous stability criteria can be applied to the problem of an airframe subject to a step-function elevator deflection, provided that the aerodynamic derivative z_q is negligible. When z_q is not small, special treatment of the stability problem is required and it is shown that the critical value of the elevator step-function which will cause instability can fairly readily be obtained from quantities taken from the elevator trim curves. Author

N65-31049*# California Inst. of Tech., Pasadena. Graduate Aeronautical Lab.

INSTABILITY OF CYLINDRICAL SHELLS SUBJECTED TO AXISYMMETRIC MOVING LOADS

G. A. Hegemier Jul. 1965 34 p refs

(Grant NsG-18)

(NASA-CR-64092) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Using a Donnell type nonlinear theory and the stability in the small concept of Poincaré, the instability of an infinite-length cylindrical shell subjected to a broad class of axisymmetric loads moving with constant velocity is studied. Special cases of the general loading function include the moving ring, step and decayed step loads. The analysis is carried out with a double Laplace transform-functional difference technique. Numerical results are presented for the case of the moving ring load. Author

N65-31067# Southampton Univ. (England). Inst. of Sound and Vibration Research.

NOTE ON THE USE OF CROSS CORRELATION IN STUDYING THE RESPONSE OF LIGHTLY DAMPED STRUCTURES TO NOISE

B. L. Clarkson and C. A. Mercer Nov. 1964 24 p refs

(Contract AF 61(052)-504)

(ISAV-MEMO-116)

Thia note describes a method of estimating the frequency response function of a lightly damped single degree of freedome system from a truncated measurement of the cross correlation function of white noise excitation and response. Application to a multi-degree of freedom system is discussed and an actual example given. The method gives an improved estimate of the damping of the predominant modes of the system.

Author

N65-31089# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.

PLASTIC DEFORMATION OF STRUCTURES. I: PLASTIC DEFORMATION OF BEAMS

E. N. Clark, F. H. Schmitt, D. G. Elfington, I. A. Engle, and S. Nicolaides Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1965 290 p refs

(Contract AF 33(657)-3-RD-360)

(FDL-TDR-64-64; AD-616330)

An experimental technique of explosively deforming basic structural elements by a precise impulse imparted to the structure. The basic structure in this case is a beam and the impulse is predetermined by the explosive weight. The experiment is monitored by both streak and framing cameras and strain gauges. The data when reduced provides deflection modes and deflection time history of the experiment specimen. Author

N65-31139*# Allied Research Associates, Inc., Concord, Mass.

AEROSPACE PRESSURE VESSEL DESIGN SYNTHESIS

George Gerard Washington, NASA, Aug. 1965 59 p refs

(Contract NASw-928)

(NASA-CR-287) CFSTI: HC $3.00/MF $0.50 CSCL 20K

A governing structures-materials-design synthesis relationship is derived for the primary structural weight of membrane type pressure vessels. The structural efficiency is associated with the configuration and the failure law characterizing the material used. Closed pressure vessels of various shapes utilizing monolithic and filamentary materials are examined in some detail to establish optimum designs. The structural strength/weight ratio has a profound influence upon the pressure vessel efficiency. Values of this ratio realized currently in monolithic and filamentary designs are evaluated. Likewise, the potential of anisotropic metals, filamentary-monolithic composites and whisker composites is studied. The configuration and material efficiencies are then combined to investigate the comparative efficiencies of pressure vessels of various shapes and materials concepts. Author

N65-31144*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

STRESS AND STRAIN DISTRIBUTIONS IN A THICK-WALLED CYLINDER OF STRAIN-HARDENING MATERIAL, ELASTIC-PLASTICALLY STRAINED BY INTERNAL PRESSURE

C. K. Liu Washington, NASA, Aug. 1965 25 p refs

(NASA-TN-D-2941) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An attempt is made to extend Allen and Sopwith's solution for an elastic-plastic thick-walled cylinder of ideally plastic material to strain-hardening material. Tresca's criterion of yielding is modified so that the effective stress (usually considered a function of the effective strain) is proportional to a simple power function of the radius in the plastic zone. An analysis of Allen and Sopwith's solution for ideally plastic materials seems to support and justify the proposed modification of the yielding criterion. The exponent of the power function is taken as $-3/2$, $-5/4$, -1, and $-1/2$, in each case yielding an analytic solution corresponding to a particular strain-hardening material. Examples worked are for the case of plane strain and for a ratio of outer to inner radii of 2.0. When the exponent is taken to be zero, the solution becomes identical to that of Allen and Sopwith. For exponents other than the five mentioned above, numerical or graphical methods of integration may be used. Author

N65-31182*# Hexcel Products, Inc., Berkeley, Calif.

ENERGY ABSORBING CHARACTERISTICS OF CRUSHABLE ALUMINUM STRUCTURES IN A SPACE ENVIRONMENT—DEVELOPMENT AND FABRICATION OF BENDIX ENERGY ABSORPTION CAPSULES Final Materials Report, Addendum No. 2

J. Brentjes South Bend, Ind., Bendix Corp., 1 Jun. 1965 82 p Prepared for Bendix Corp.

(Contract NAS9-2074)

(NASA-CR-65095; SPR-65-107, Addend. 2) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The design, development, and fabrication of honeycomb attenuators for energy absorption has resulted in a more advanced and broader understanding of the many variables, phenomena, and core characteristics associated with aluminum

honeycomb as a media for energy absorption. The final fabrication techniques are summarized: (1) The most efficient honeycomb core for relatively low crush strength levels is regular expanded honeycomb. (2) Solid cylinders of cross-core exhibited better crush characteristics in the higher crush strength levels than in the low range. (3) Annular cylinders for energy absorption were made of tube core. (4) The physical dimensions of the capsule were important in obtaining uniform crush characteristics. (5) A single splice without precrushing the sections has proven successful. Additional findings included: wrapping the capsules with a glass filament tape prevented peeling of outside cells, cross-core made with a flat sheet between each corrugated sheet resulted in more uniform crush characteristics; and crush strength was reduced by annealing aluminum honeycomb at 450° F. R.W.H.

N65-31183*# Bendix Corp., South Bend, Ind. Advanced Structures Group.
ENERGY ABSORBING CHARACTERISTICS OF CRUSHABLE ALUMINUM STRUCTURES IN A SPACE ENVIRONMENT Final Engineering Report, Sep. 30, 1963–Jul. 24, 1965
F. P. Mackrill et al 24 Jul. 1965 277 p refs
(Contract NAS9-2074)
(NASA-CR-65096; SPP-65-107) CFSTI: HC $6.00/MF $1.50 CSCL 20K

The basic objective was to obtain quantitative design data on the characteristics of aluminum honeycomb materials when used in high L/D ratio crushable energy absorbing capsules. Nine configurations of honeycomb energy absorbing capsules using alloy 5056 were evaluated. Three cross sectional shapes of high, medium, and low crush strength, each of which was fabricated with cell axes oriented at angles of 0°, 15°, and 30° to the capsule longitudinal axes were studied. Particular characteristics which were investigated included specific energy, load onset rate, and rebound. Variations of these characteristics were studied under controlled environmental conditions. The capsules were subjected to both static and dynamic loads, impact velocities from 5 through 20 feet per second, and impact weights varying from 760 through 3750 lbs. The environmental extremes under which the specimens were tested spanned the temperature range from −260° F to 300° F and a vacuum of 3×10^{-1} Torr. E.W.

N65-31194# Martin Co., Denver, Colo.
ITL MAST-FRAME FULL SCALE VIBRATION TEST Test Report
J. Newgent Jul. 1965 27 p
(Contract AF 04(695)-150)
(SSD-CR-65-149; AD-466845)

A vibration test was conducted on the Titan III integrated transfer launch frame and mast structure as part of a test program to determine the extent of wind induced oscillation on the mast. Tests were conducted on the pitch, torsion, and yaw modes of the piers and undercarriages of the structure. Test data are tabulated and modal plots of the masts and frames are included for cases where significant deflection was observed. The data were concluded to be valid and can be used to verify the dynamic properties of a wind tunnel model which is being constructed. R.N.A.

N65-31201# Naval Weapons Lab., Dahlgren, Va. Warhead and Terminal Ballistics Lab.
STRESS ANALYSIS OF A DAMAGED TRUSS BRIDGE Technical Memorandum
W. G. Soper Jun. 1964 29 p
(NWL-T-9/64; AD-618732)

A method is presented for determining the loads and deflections in a damaged truss bridge. Any combination of completely or partially severed components can be treated. The analysis is based upon pinned joints, linear force-deflection relations, and simple tensile or compressive loading for all structural members. Application of the method to a bridge containing 116 members is described, and certain results are included. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-30210 Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET DETONATION RESEARCH AND ITS SIGNIFICANCE FOR AEROSPACE PROPULSION
Paul Vantoch *In its* Foreign Sci. Bull., Vol. 1, No. 7 Jul. 1965 p 11–13 refs (See N65-30207 19-34)

Two recent Soviet articles one dealing with the detonation research conducted by the 1965 Lenin Prize winners and the other a popular survey of detonation studies, are reviewed and discussed. Some conclusions concerning general trends in Soviet detonation research are drawn, and its possible significance for the development of propulsion systems is pointed out. Author

N65-30417 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF PRESSURE ON DISTURBANCE OF STABILITY OF COMBUSTION OF POROUS EXPLOSIVES
A. F. Belyayev, A. I. Korotkov, and A. A. Sulimov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 185–192 refs (See N65-30400 19-23)

The penetration of combustion of a burning explosive to the interior of a porous explosive thereby increasing the combustion surface and the speed of gasification is discussed. The relation of pressure to this phenomenon was investigated with elongated charges 10 mm in diameter of various porosity. It was observed that as long as a stable combustion layer was maintained, a smooth acceleration buildup of pressure with time was characteristic of the reaction. Disturbance of the combustion layer and combustion breakthrough to the pores was noted by a discontinuity in the pressure-time relation. This breakthrough in porous materials is examined in detail. E.E.B.

N65-30418 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON INFLUENCE OF PRESSURE ON COMBUSTION RATE OF AMMONIUM PERCHLORATE
A. P. Glazkova *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 193–202 refs (See N65-30400 19-23)

The influence of pressures to 1000 atm on the combustion rate of ammonium perchlorate was investigated. Photographs were made of the combustion process. It was observed that the dependence of the combustion rate on pressure for this material differed considerably from that of other explosives. There was a reduction in combustion rate with pressure and the combustion was characterized by instability under these conditions. It has been suggested that this phenomenon is related

to the phase change which occurs during thermal decomposition of the perchlorate at 240° C. This suggestion, however, requires experimental verification. E.E.B.

N65-30419 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON HEAT EXCHANGE OF MICROTHERMOCOUPLES UNDER CONDITIONS OF COMBUSTION OF CONDENSED SUBSTANCES
A. A. Zenin *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 203–215 refs (See N65-30400 19-23)

Parameters are considered for thermocouples to ensure a minimum of temperature profile distortion. The heat exchange was studied for thermocouples in condensed and gas media under conditions similar to those existing in the measurement of temperature in combustion waves. It is shown that the sealing of thermocouples can lead to large errors and serious distortion of temperature profiles. E.E.B.

N65-30420 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISPERSION AND ACCIDENTAL ERROR OF MEASUREMENT OF TEMPERATURE OF LOCALLY ISOTROPIC TURBULENT FLOW
Yu. L. Rozenshmok *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 216–222 refs (See N65-30400 19-23)

The determination of accidental errors in the measurement of temperature of locally isotropic turbulent flow is considered. Equations are derived for the determination of dispersion and accidental error for thermometric bodies having plane, cylindrical, and spherical shapes. It is shown that optimum properties in the sense of minimum accidental error belongs to the spherical thermal receiver and that the thermometer plate has the poorest properties. E.E.B.

N65-30421 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ONE NONLINEAR PROBLEM OF THERMAL CONDUCTION
S. I. Anisimov and T. L. Perel'man *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 223–226 refs (See N65-30400 19-23)

The one-dimensional boundary problem is examined in detail for the nonlinear differential equation

$$\frac{\partial T}{\partial t} = \alpha \Delta T + q \exp\left(-\frac{\varepsilon}{T}\right)$$

which is encountered in thermal explosion and thermal conductance theory. The right side of the equation approximately describes the thermal divisions during chemical reaction and the constant E signifies the activation energy for the reaction. By the introduction of dimensionless variables and Green's function of heat conduction, the differential equation is reduced to an integral equation which is solved by successive approximations for various temperature distributions. E.E.B.

N65-30422 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON HEAT EXCHANGE AT CRITICAL POINT OF A BLUNT BODY AT SMALL REYNOLDS NUMBERS
I. N. Murzinov *In its* J. of Appl. Mech. and Tech. Phys. 8 Feb. 1965 p 229–234 refs (See N65-30400 19-23)

Heat exchange parameters are determined at the critical point for small Reynolds numbers on the basis of an analysis of the hypersonic flow around spheres. Also, the influence of small Reynolds numbers on the flow of bodies of other configurations are considered. The function derived from theoretical considerations is compared with experimental results. E.E.B.

N65-30520# European Atomic Energy Community, Brussels (Belgium).
EVALUATION OF CALCULATIONS ON THE PROBLEM OF HEAT TRANSFER BY RADIATION IN SOLIDS. [AUSWERTUNG VON RECHNUNGEN ZUM PROBLEM DER WARMELEITUNG DURCH STRAHLUNG IN FESTKORPERN]
J. Richter and H. E. Schmidt Apr. 1965 20 p refs In GERMAN; ENGLISH summary
(EUR-2409.d) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186; 40 Belg. Fr.

The temperature profile acorss a slab in the case of interacting phonon conduction and radiative heat transfer is described by an integro-differential equation. Numerical solutions of this equation are described in the text. In several cases of practical interest an "effective thermal conductivity" is calculated and its dependence on temperature and specimen thickness are shown. One finds that under conditions which normally persist in high temperature diffusivity experiments the influence of radiative conduction is negligible in monocrystalline UO_2-platelets which are less than 1 mm thick. The contribution of radiation increases however rather rapidly with increasing thickness. The measured thermal conductivity thus depends in "thick" samples strongly on the specimen dimensions. This could help to explain why in some cases different authors found inconsistent results in high temperature thermal conductivity measurements on comparable materials. Author

N65-30554 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A CALORIMETRIC DEVICE FOR THE MEASUREMENT OF TOTAL HEMISPHERICAL EMITTANCE
Robert Ian Mc Dowell (M.S. Thesis) Aug. 1963 110 p refs (GA-ME-63-3; AD-419456)

A small experimental apparatus is designed for the measurement of total hemispherical emittance of thin flat disc specimens over the temperature range of 0° F to 300° F. It is a steady-state device which employs thermal radiation from a hot wall for specimen heating. An equation is developed for the calculation of specimen emittance for which only temperatures need be measured. A partial evaluation of the device, for temperatures between 40° F and 100° F, justifies an anticipated maximum error of ±3% for high emittance specimens. Author

N65-30557# Maremont Corp., Pasadena, Calif. Research and Development Labs.
STUDY OF ROCKET ENGINE EXHAUST PRODUCTS Quarterly Report, 1 Nov. 1964–31 Jan. 1965
M. A. Greenbaum, R. E. Yates, J. A. Blauer, M. A. Frisch, M. Arshadi et al [1965] 30 p refs
(Contract AF 04(611)-7414)
(QR-14; AD-612892)

From a study of the reaction $2Al\ (l) + AlF_3(g) \rightleftharpoons 3AlF(g)$ between 1199° and 1348° K by means of the transpiration technique a ΔHr 1273° K of 93.35 ±1.78 kcal and a ΔSr 1273° K of 62.15 ±1.37 cal/deg/mole were obtained. Extrapolation to 298° K by means of published thermal functions coupled with the use of published thermodynamic data for Al and AlF_3 yields values of −60.65 ±0.59 kcal/mole and 51.93 ±0.46 cal/deg/mole for the ΔHf 298 and S° 298 for AlF(g) respectively. The ΔH_f 298 for AlCl(g) of −13.5 ±0.4 kcal/mole is reported based on the first experimental second law measurements for the reaction $2Al(l) + AlCl_3\ (g) = 3\ AlCl(g)$ by a Molecular Flow

Effusion study over the temperature range 930° K to 1034° K. The first experimental value for $S°_{298}$ of $AlCl_3(g)$ of 82.5 ±1.5 cal/deg/mole is also derived from these measurements. Author

N65-30599*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF COMBUSTION PROCESS ON STABILITY
Richard J. Priem Washington, NASA, Aug. 1965 28 p refs Presented at the 56th Natl. Meeting, AIChE, San Francisco, 16–19 May 1965
(NASA-TN-D-2957) CFSTI: HC $2.00/MF $0.50 CSCL 21B

The relative importance of various steps in the combustion process on combustion instability was compared theoretically by assuming that individual steps controlled the growth of a disturbance. The combustion steps involved the time dependence of (1) propellant injection, (2) accumulation of unburned propellant, (3) propellant atomization, (4) propellant vaporization, and (5) chemical reaction. The calculation gave stability limits (minimum disturbance that will grow to instability) with various steps considered to control the combustion rate. The calculations show that chemical reaction is the most sensitive mechanism, but if accumulation of unburned propellants is included, the chemical reaction step is likely to be important only for low conversion rates that do not occur in most rocket combustors. With realistic combustion conditions the physical processes of vaporization and atomization appear to be the most important in determining instability limits, the limits for each step depending on the accumulation of unburned propellant and vortex velocity. Experimental instability studies with an 8-foot torus combustor, which is similar in geometry to that used for the theoretical calculations, confirmed the calculated results. Experiments also confirmed qualitatively the fluctuations that occur during instability. Author

N65-30612# Institutt for Atomenergi, Kjeller (Norway).
"VOIFLO I". A STEADY STATE FORTRAN CODE FOR THE HYDRAULICS OF A BOILING LOOP
K. O. Solberg, P. Bakstad, and J. Rasmussen Dec. 1964 66 p refs
(KR-85)

The report describes a digital computer program "VOIFLO I", which computes the steady state hydraulics of a boiling loop consisting of a heated channel, a riser part, and a downcomer. The "VOIFLO" code calculates the circulation velocity and the detailed distributions of quality, void fraction, water velocity, slip ratio, and pressure along the flow path. Inputs to the code are the power distribution, geometrical and material data. The code is written in FORTRAN. Subcooled boiling, water flashing, and variable slip along the channel are included; these are important effects under certain conditions. Comparisons with experimental data from loops show that very good agreement can be obtained. Certain parameters in the slip and friction correlations must, however, be chosen as dependent upon the experimental conditions (pressure and geometry). The need for high precision measurements is realized to obtain general correlations for slip and two-phase friction. The determination of these is outside the scope of this report. Author

N65-30639*# Michigan Univ., Ann Arbor.
A STUDY OF TWO PHASE DETONATION AS IT RELATES TO ROCKET MOTOR COMBUSTION INSTABILITY
J. A. Nicholls, E. K. Dabora, and K. W. Raglano Washington, NASA, Aug. 1965 106 p refs
(Contract NASr-54(97))
(NASA-CR-272) CFSTI: HC $4.00/MF $0.75 CSCL 21B

A simplified treatment of the jump conditions in two phase detonations that takes into account a change in the molecular weight and the ratio of the specific heats is made. It shows significant differences between these jump conditions and their all-gaseous counterparts. The experimental setup for studying two phase detonations is described. Detonation or "detonation-like" waves propagating at 5300–5700 ft/sec are observed in diethylcyclohexane sprays in gaseous oxygen. A pressure ratio of the order 30 which is too high for a Chapman–Jouguet wave but compatible with its associated shock wave is observed. The speed of the wave is lower than what is expected theoretically, apparently because of incomplete combustion. Detonation waves at even lower velocities are also observed when the walls of the detonation tube are wetted by the fuel. This observation is considered significant to rocket motor instability. Author

N65-30720*# General Electric Co., Philadelphia, Pa. Reentry Systems Dept.
ANALYTICAL COMPARISONS OF ABLATIVE NOZZLE MATERIALS Final Report, Jun. 20, 1963–Nov. 20, 1964
F. E. Schultz and P. B. Cline 1 Jul. 1965 387 p refs
(Contract NAS3-2566)
(NASA-CR-54257) CFSTI: HC $7.00/MF $2.00 CSCL 20M

A Reaction Kinetics Ablation Program was developed to analytically predict the ablation performance of rocket nozzle heat protection materials. The program was written in FORTRAN IV and made compatible with the NASA Lewis computation facilities. The program can be used to predict the thermal degradation of a wide variety of materials exposed to an external source of heat. The program includes the effects of mass addition on heat transfer, the calculation of internal gas pressure and internal material stresses and a number of other options for surface or char removal. The comparative performance of phenolic nylon, phenolic graphite and phenolic refrasil as rocket nozzle heat protection materials was investigated. The results are reported for these materials exposed to the heating environment produced by the propellant combinations of hydrogen/oxygen and N_2O_4UDMH–N_2H_4(50-50). Author

N65-30721*# Aerojet-General Corp., Azusa, Calif. Von Karman Center.
THERMAL STRAIN ANALYSIS OF ADVANCED MANNED SPACECRAFT HEAT SHIELDS Final Report
E. L. Wilson and A. Zukerman Oct. 1964 215 p *Its* Rept-5654-02-FS
(Contract NAS9-1986)
(NASA-CR-65063) CFSTI: HC $6.00/MF $1.25 CSCL 20M

Numerical methods and digital computer programs are presented for the thermal strain analysis of manned spacecraft heat shields. The finite element technique is used to determine stresses and displacements developed in composite axisymmetric solids of arbitrary geometry subjected to axisymmetric thermal or mechanical loads. This technique is then applied to the development of an automated computer program for the analysis of axisymmetric heat shields subjected to axisymmetric thermal and pressure loadings. The numerical technique is extended to the analysis of heat shields subjected to non-axisymmetric thermal loading. Several examples are presented to illustrate the application of the method and to demonstrate its validity. Fortran II card listings and descriptions of the use of the computer programs are given in the appendices. R.N.A.

N65-30749# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF CHARGES DURING MASSIVE EXPLOSIONS FOR THROWING-OUT

G. I. Pokrovskiy and A. A. Chernigovskiy 29 Jan. 1965 92 p Transl. into ENGLISH of "Raschet Zaryadov Pri Massovykh Vzryvakh Na Vybros" Moscow, Gos. Nauchno-Tekhn. Izd. Lit. po Gornomy Delu, 1962 p 1–88
(FTD-MT-64-253; AD-613987)

A method for the calculation of the explosive charge required for earth removal in open pit mining, in construction of transport, and hydro-technical constructions is presented. Also, ballistic tables are given for slant range and vertical displacement of earth ejected by explosion as functions of the initial velocity of ejection, drag coefficient, and time. Instructions are included for the construction of the trajectory of earth motion for a given direction of ejection. E.E.B.

N65-30857# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
THERMODYNAMICS AND WAVE PROPAGATION
Bernard D. Coleman (Mellon Inst.) and Morton E. Gurtin 2 Apr. 1965 18 p refs
(Contract Nonr-562(10))
(TR-100; AD-616748)

Some aspects of the classical theory of wave propagation in finitely deformed elastic materials are discussed. Recent extensions of the classical theory to materials with memory are discussed. Author

N65-30874# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
HEAT TRANSFER FROM ARGON AND XENON TO THE END-WALL OF A SHOCK TUBE
Harvey S. Friedman and James A. Fay May 1965 34 p refs
(Contract AF 49(638)-1396)
(Publ.-65-2; AD-617055)

Heat transfer from argon and xenon to the end-wall of a shock tube has been measured by using a thin-film heat transfer gage whose temperature rise is monitored by an infrared photocell. For the range of incident shock Mach numbers tested, between 9 and 13 in argon and 13 and 18 in xenon, partial ionization would exist behind the reflected shock wave if thermodynamic equilibrium were achieved. By extrapolation of measured ionization rates for these gases, it was concluded that no ionization occurred behind the reflected shock wave in argon but that equilibrium was achieved in xenon, at least for the period during which the heat transfer was measured. Calculations of the heat transfer, made in accordance with existing theories for the corresponding thermodynamic state of the gas, were found to be in good agreement with the experimental measurements. Author

N65-30886# Michigan Univ., Ann Arbor. Dept. of Aeronautical and Astronautical Engineering.
THE INFLUENCE OF WATER VAPOR ADDITION ON HYDROGEN–OXYGEN DETONATIONS
B. F. Kerkam and E. K. Dabora Apr. 1965 41 p refs *Its* Rept.-06996-1-T
(Contract DA-31-124-ARO(D)-299)
(AROD-5209-1; AD-617962)

The minimum detonation Mach number, below which detonative combustion is not possible, can be predicted by Belles' explosion limit criterion for H_2-O_2 mixtures. The criterion predicts also that the addition of water vapor increases this minimum Mach number. The experiments which are described here and which are based on the technique of slowing down an established Chapman-Jouguet detonation wave by exposing one of its sides to a compressible boundary verify this prediction. It is found that the addition of 2% water vapor to a stoichiometric H_2-O_2 mixture increases the minimum detonation Mach number by 3% as predicted by theory. It is also found that the same amount of water vapor decreases the reaction length by approximately 50% and that the addition of 1% of water vapor to 50% hydrogen-50% oxygen mixtures reduces the reaction length by approximately 30%. The experimental work of Kistaikowsky and Kydd is found to support the latter findings. Author

N65-30888# Phillips Petroleum Co., Bartlesville, Okla. Research and Development Dept.
HIGH PRESSURE COMBUSTOR STUDIES OF FLAME RADIATION AS RELATED TO HYDROCARBON STRUCTURE Progress Report No. 3
R. M. Schirmer and H. T. Quigg 20 May 1965 118 p refs
(Contract NOw-64-0443-d)
(Rept.-3952-65R; AD-617191)

Measurements have been made of the total radiant energy from flames of 25 different fuels in a combustor operating at 22 different conditions. The test fuels consisted of a series of pure hydrocarbons, varying widely in molecular structure and boiling point, and a group of JP-5 fuels, blended to rigidly control hydrocarbon type and aromatic structure. This study was conducted using the Phillips 2-inch diameter research combustor, which simulates conditions for combustion in an aviation turbine engine. The basic experiment was designed to determine the effect of combustor operating variables and fuel variables on flame radiation. Each test fuel was evaluated at two levels of the four combustor operating variables in a completely randomized design. Data were obtained at 16 different operating conditions. Flame radiation increased with increasing combustor pressure, inlet air temperature and heat input rate, and decreased with increasing flow velocity. A satisfactory relationship was established between flame radiation and fuel hydrogen content, for a given operating condition. Author

N65-30899*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SHOCK-TUBE GAS TEMPERATURE MEASUREMENTS BY INFRARED MONOCHROMATIC RADIATION PYROMETRY
Milton R. Lauver, Jerry L. Hall, and Frank E. Belles Washington, NASA, Aug. 1965 13 p refs
(NASA-TN-D-2955) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Gas temperature histories in a shock tube were determined by an infrared monochromatic radiation pyrometer technique. A 10 percent carbon dioxide-argon mixture was studied with both incident and reflected shocks. Measured temperatures of 1100° to 3300° K immediately behind the incident shocks were in good agreement with the temperatures calculated by one-dimensional wave theory from the shock velocity. Measured temperatures of 1900° to 3550° K behind reflected shocks were in good agreement for short reflection distances with those calculated by one-dimensional wave theory from the incident shock velocity. The relation between the velocity attenuations and the temperature and pressure rises behind incident shocks was in general agreement with strong shock theory. The change in gas temperature with time behind a reflected shock was adequately calculated from the dissociation rate of carbon dioxide and the measured pressure history of the gas mixture. Author

N65-30932# Rocketdyne, Canoga Park, Calif.
PRODUCT ENGINEERING. TASK II: HEAT TRANSFER PART I Final Program Progress Report, 1 Jan. 1964–1 Mar. 1965
1 Apr. 1965 199 p refs
(Contract AF 04(694)-110)
(R-5652-4P; AD-466657)

Presented is a detailed summary of Product Engineering Program progress conducted under Task II, Heat Transfer

Studies to extend the knowledge gained in CY 1963 concerning the regenerative-cooling characteristics of nitrogen tetroxide (N_2O_4) at high pressures. Experimental tests were conducted in electrically heated tubes to determine limiting heat flux conditions, critical pressure region effects, tube materials compatibility, and influence of tube curvature including symmetric and asymmetric heating conditions. A typical shaped thrust chamber coolant tube of advanced design was employed as a heat transfer test section to demonstrate these effects. The work was accomplished during the period from 1 January 1964 through 1 March 1965. Author

N65-30935# RAND Corp., Santa Monica, Calif.
THE THERMODYNAMICS OF THE TEFLON-FLUOROCARBON VAPOR SYSTEM
F. J. Krieger Jul. 1965 32 p refs
(Contract AF 49(638)-700)
(RM-4634-PR; AD-468229)

The purpose of this study is the thermodynamic investigation of Teflon over a range of temperatures up to 6000° K and pressures up to 10^5 atmospheres. Two sets of equilibrium composition equations are used—one representing a pure gas phase, the other a heterogeneous system of gas and solid carbon. The gas phase of the heterogeneous chemical system, like the homogeneous gas phase, comprises 14 gaseous carbon fluorine, and fluorocarbon species. The results of the computational program are presented in both tabular and graphic form. The latter is a conventional Mollier diagram in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight. Author

N65-30938# Iowa State Univ. of Science and Technology, Ames.
BASE RECIRCULATION EFFECTS DUE TO INTERACTION OF JETS
Lawrence Hugh Stein (Ph.D. Thesis) Ann Arbor Mich., Univ. Microfilms, 1964 68 p refs

A theoretical model to explain the fundamental causes of base recirculation is proposed. An experimental investigation was conducted using a pair of two-dimensional supersonic air jets to verify the results predicted by the theoretical model. It was observed that the deflection angle, θ, which was measured from the schlieren photographs, was within two degrees of the predicted value for the two Mach numbers tested. The shock wave angle data displayed about two degrees maximum deviation from predicted values. The angle $\beta - \theta$ was measured from the centerline between nozzles to the centerline of the shock wave. The experimental base flow data differed from the predicted values by approximately 20% in the low pressure ratio range, and by about 10% at the end of the pressure ratio range tested. The theoretical model gave correct qualitative results and showed the same trend as the data. R.W.H.

N65-30998 Joint Publications Research Service, Washington, D. C.
ERRORS CAUSED BY THE APPLICATION OF PLATO HEAT ANALYSIS METHOD TO THE OVERCOOLING OF MOLTEN BODY
Ch'ung-fan Ho, P'ei-chun Li, and Chan Yueh *In its* Transl. on Communist China's Sci. and Technol., No. 202 9 Aug. 1965 p 93–98 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 5, May 1965 p 454–456 (See N65-30991 19-34) CFSTI: $4.00

Fluoromica synthesis cooling curve measurements gave different values when the molten body crystallized under different overcooling temperatures. The major reason for this inaccuracy was found to be the overcooling process effects on the crystallization time. A heat differential analysis conducted from measurements of the crystallization area heat and the crystallizing time difference obtained correct values. G.G.

N65-31014*# Southern Research Inst., Birmingham, Ala.
THE TOTAL NORMAL ABSORPTANCE OF A LAMPBLACK COATING ON COPPER Final Report
2 Apr. 1965 31 p refs
(Contract NAS8-5196)
(NASA-CR-64360) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The total normal absorptance of a thin lampblack coating on a smooth, clean, copper surface over a temperature range of 70° to 1500° F was determined by measuring the emittance of the coating and assuming emittance equal to absorptance. This assumption was confirmed by Kirchoff's law. The emittance was measured by comparing the energy received by a radiometer from the sample to that received from a blackbody at the same temperature. The lampblack coating exhibited a total normal emittance that remained constant at 0.90 over the entire temperature range. R.W.H.

N65-31028# College of Aeronautics, Cranfield (England).
SOME REMARKS ON THE TREATMENT OF FULLY-SUPERSONIC OBLIQUE FLAMES AS GAS-DYNAMICAL DISCONTINUITIES
J. F. Clarke Feb. 1965 13 p refs
(CoA-AERO-179)

The conservation equations are solved for the changes occurring across a steady plane exothermic discontinuity. Using the deflagration branch of these solutions, conditions for the flow to be supersonic on both the "burnt" and "unburnt" sides of the flame are established. Simple flows capable of sustaining such fully-supersonic flames can therefore be constructed quite readily, and two examples are given. The second of these corresponds to an experimentally observed case of shock-induced combustion. The analysis is simplified as much as possible and the work is purely heuristic. Author

N65-31037*# Miami Univ., Coral Gables, Fla. Mechanical Engineering Dept.
BOILING FLOW INSTABILITY Semiannual Status Report
A. H. Stenning and T. N. Veziroglu May 1965 22 p refs *Its* Rept.-7
(Grant NsG-424)
(NASA-CR-64319) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A new series of experiments were conducted with a different system geometry in the investigation of inlet pressure drop versus overall density ratio relationships for the density wave type oscillations. The results are in agreement with earlier experiments and indicate that a one-component two-phase flow system is more stable than a two-component two-phase flow system. Two series of experiments with and without exit restrictions were conducted to investigate the subcooling versus mass flow rate relationships at the stability boundary of density wave type oscillations. For the range studied, the curves at constant power input have S shapes with acute angled bends. This feature of the curves for Freon-11 is in contrast with smoothly inverted C shaped curves obtained for water. Some experiments were conducted to determine the mechanism causing the pressure drop type oscillations. Results indicate that during the oscillations the heat flux to the fluid changes although the heat generated in the heater is constant. R.N.A.

N65-31096# Witwatersrand Univ., Johannesburg (South Africa). Dept. of Mechanical Engineering.
FLAME PROPAGATION VELOCITY AND SOME RELATED TOPICS—A BIBLIOGRAPHY

Rhona Smith, comp. Mar. 1965 124 p refs
(Rept.-28)

A bibliography on flame propagation velocity is presented. Literature on related topics necessary in the understanding and determination of this parameter is included. The primary source used in compiling the bibliography was the Engineering Index.
E.E.B.

N65-31186*# General Dynamics/Convair, San Diego, Calif.
INVESTIGATION AND ANALYSIS OF THE APPLICATION OF A HEAT PUMP IN THERMAL CONTROL SYSTEMS FOR A MANNED SPACECRAFT Final Report
Aug. 1965 324 p refs
(Contract NAS9-3523)
(NASA-CR-65116; GD/C-65-120) CFSTI: HC $7.00/MF $1.75 CSCL 20M

Heat pump systems for space vehicle thermal control in a lunar environment were reviewed and evaluated. Related component performance characteristics, weights, and reliability were used to define and evaluate the systems. Heat pump systems were investigated for 0° to 600° R lunar orbital and surface sink temperature range, refrigerants R-11 and R-718, 600° to 850° R condensing temperature range, 492° to 610° R evaporating temperature range, and a 1 to 10 thermal kilowatt heat rejection range. It is concluded that an R-11 to R-718 cascade heat pump system can be designed and developed. The system selection was based on minimum weight and the conclusion that it can be designed to operate continuously throughout the lunar mission.
R.N.A.

N65-31224# Martin Co., Baltimore, Md.
RADIATING SHOCK LAYERS
K. C. Wang Jun. 1965 68 p refs
(RR-67)

Thermal radiation effects on hypersonic shock layers are considered. Part I deals with the one-dimensional unsteady plane "piston problem" with finite optical thickness. Part II deals with steady flows over symmetric bodies in the transparent limit. The zeroth order approximation in a series expansion in the density ratio across the shock is carried out. Results are mostly in simple closed form; a few require a quadrature. In the piston problem where direct comparison is possible for certain similar flows, agreement between the present results and the exact numerical results is generally good. In the transparent limit, the temperature, in general, decreases monotonically behind the shock. In the thick limit, the temperature exhibits a boundary-layer-like behavior near the two ends, but follows the nonradiating solution in the middle part. For the particular case of a shock propagating with constant speed, this middle part becomes isothermal. The density increase is almost inversely proportional to the decrease of temperature. The shock distance is reduced from the nonradiating value, but no minimum shock distance other than zero exists.
Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-30207# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME I, NO. 7 Monthly Review of Selected Foreign Scientific and Technical Literature
Jul. 1965 62 p refs
(AD-617276)

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3. SOVIET DETONATION RESEARCH AND ITS SIGNIFICANCE FOR AEROSPACE PROPULSION P. Vantoch p 11–13 refs (See N65-30210 19-33)
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7. NEW DESIGN PRINCIPLES IN SOVIET LAUNCH-VEHICLE DEVELOPMENT A. Dolgich p 31–33 refs (See N65-30214 19-31)
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N65-30275# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 198
26 Jul. 1965 84 p refs Transl. into ENGLISH from Chinese periodicals
(JPRS-31229; TT-65-31726) CFSTI: $3.00

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N65-30382* Bureau of Commercial Fisheries, Stanford, Calif. Biological Lab.
OCEANOGRAPHIC OBSERVATIONS FROM MANNED SATELLITES FOR FISHERY RESEARCH AND COMMERCIAL FISHERY APPLICATIONS
J. F. T. Saur *In* Woods Hole Oceanog. Inst. Oceanog. from Space Apr. 1965 p 313–314 ref (See N65-30350 19-13)
CFSTI: HC $7.45/MF $2.25

Suggestions for oceanographic or fisheries research include visual, photographic, or televised observations of marine flora and fauna; locations of fishing boats and fleets; marker, transponding, and command buoys for assessing wind and current structure and for observing diffusion in the atmosphere

and ocean; laser radar or light detecting and ranging (LIDAR) to observe turbulence and to improve sea surface charts; and productivity of the ocean. M.W.R.

N65-30468*# Washington Univ., St. Louis, Mo. Dept. of Economics.
ATTRITION OF GRADUATE ENGINEERS
Hugh Folk 23 Jun. 1965 15 p refs *Its* Working Paper No. 6512
(Grant NsG-342)
(NASA-CR-64114) CFSTI: HC $1.00/MF $0.50 CSCL 05I

Statistical methods are used to estimate the overall attrition rate of graduate engineers for the various engineering specialties. It was assumed that the stock of employed engineers in 1950 grows at a gross compound rate γ and is subject to attrition at a compound rate α over the period 1950–1960. Formulas are calculated from these assumptions. The estimates presented exceed by a considerable amount other similar government estimates. Data are tabulated. L.S.

N65-30479*# Washington Univ., St. Louis, Mo. Dept. of Economics.
AN ANALYSIS OF REGRESSION ESTIMATORS FOR URBAN EMPLOYMENT MULTIPLIERS AND THEIR APPLICATION TO THE EMPLOYMENT IMPACT OF THE AEROSPACE INDUSTRY IN THE ST. LOUIS STANDARD METROPOLITAN STATISTICAL AREA
Se-Hark Park (Ph.D. Thesis) Jun. 1965 118 p refs
(Grant NsG-342)
(NASA-CR-64088) CFSTI: HC $4.00/MF $0.75 CSCL 05C

A study is presented that analyzes through multiple regression estimation methods, the multiplier effects on the local employment in the St. Louis Standard Metropolitan Statistical Area resulting from monthly variations in investment and in the aerospace and other major export activities from January, 1958, to June, 1964. The study is presented in six chapters. Chapter II deals with export employment estimates. The model for urban employment multipliers is developed in Chapter III. Chapter IV pertains to a statistical estimation of the model for urban employment multipliers developed in Chapter III. Chapter IV is devoted to a study of the use of error formulas with time series. In Chapter V, the study utilizes multipliers obtained in an examination of the impact of a given employment change in the aerospace industry on the St. Louis area economy in terms of direct and indirect increases in the area employment. The results are summarized in Chapter VI. N.E.A.

N65-30483*# George Washington Univ., Washington, D. C.
THE MANAGEMENT OF SCIENCE
Apr. 1965 42 p refs *Its* Paper No. 8
(Grant NsG-727)
(NASA-CR-64149) CFSTI: HC $2.00/MF $0.50 CSCL 05A

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1. FUTURE GUIDANCE AND LEADERSHIP IN SCIENCE AND TECHNOLOGY S. Livermore 29 p refs (See N65-30484 19-34)
2. PARADOXES OF SCIENCE ADMINISTRATION T. A. Cowan 8 p (See N65-30485 19-34)

N65-30484* George Washington Univ., Washington, D. C.
FUTURE GUIDANCE AND LEADERSHIP IN SCIENCE AND TECHNOLOGY
Shan Livermore (Arizona Univ.) *In its* The Management of Sci. Apr. 1965 29 p refs (See N65-30483 19-34) CFSTI: HC $2.00/MF $0.50

The principal mechanisms under which scientific research is conducted and the potentialities of these as sources of national leadership are discussed in an article dealing with future guidance and leadership in science and technology. After a presentation of the over-all problem, the direct sponsorship of individual researchers is considered. Research and development in American industry and its relationship to management, universities and foundations as leaders in research, and the impact of federal agencies are discussed. The leadership role of scientists and technologists in national goal-setting is then presented. A series of practicable concepts of organization which might be applied to the future guidance-direction problem is related to intensified federal leadership, federations of academic institutions, special bodies created for long-range planning, and specialized groups as scientific pace setters. A family approach and a so-called "wild card" gambling approach are included as concepts which will aid in the development of scientific leadership. M.W.R.

N65-30485* George Washington Univ., Washington, D. C.
PARADOXES OF SCIENCE ADMINISTRATION
Thomas A. Conan (Rutgers Univ.) *In its* The Management of Sci. Apr. 1965 8 p (See N65-30483 19-34) CFSTI: HC $2.00/MF $0.50

Science administration is considered a contradiction in terms because it can limit the scientist in performing his research. An attempt is made to justify the existence of science administration, however, and it is emphasized that the administrator cannot merge administration and purely scientific work. Yet, it is stated that the scientist does need administration, and it is concluded that the role of the administrator is "to create an environment that nourishes scientific creativity." M.W.R.

N65-30547*# Martin Co., Denver, Colo.
DETERMINATION OF ROCKET ENGINE NOISE DAMAGE COMMUNITY DWELLINGS NEAR LAUNCH SITES, VOLUME I Final Report
R. W. Peverly Dec. 1964 118 p refs
(Contract NAS10-1108)
(NASA-CR-64284; CR-64-65, Vol. 1) CFSTI: HC $4.00/MF $0.75 CSCL 05E

This report presents a study to determine rocket engine noise damage thresholds of community buildings near the John F. Kennedy Space Center. The study was conducted in four phases: Phase I—literature survey; Phase II—field test and data analysis; Phase III—laboratory tests and data analysis; and Phase IV—threshold predictions. This report is divided into two volumes. Volume I contains a concise discussion of the study, including the test and analytical work. Volume II, appendix material, is a more detailed presentation of the data. N.E.A.

N65-30655 Sandia Corp., Albuquerque, N. Mex.
CLOSE-IN AIR BLAST FROM A ROW CHARGE IN BASALT Final Report
L. J. Vortman 24 Jun. 1964 66 p refs
(Proj. Dugout)
(PNE-608F) CFSTI: $3.00

Close-in air blast measurements were made on the Dugout shot (a row of five 18,000-kg high-explosive charges placed 17.9 meters below the surface in basalt). Major constituents of the blast wave were the ground-shock-induced pulse and the pulse from venting gases. The ground-shock-induced pulse was the dominant one at all stations. The pulse from venting gases was superimposed on the negative phase following the ground-shock-induced pulse; as a result, the positive pressures were less than they otherwise would have been. The ground-shock-induced overpressures perpendicular to the row were

slightly more than twice those along the axis of the row. Perpendicular to the row, they were 3.3 times single charge values but only 1.4 times single charge values off the end of the row. A third constituent of the blast wave precedes the ground-shock-induced pulse. Its timing indicates it is associated with a seismic wave. A subsequent experiment has shown that air pressure induced by the ground wave was measured. Author

N65-30922*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
[GENERAL PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION SCIENCES AND ENGINEERING] Quarterly Progress Report No. 77, Period Ending 28 Feb. 1965
H. J. Zimmerman and G. G. Harvey 15 Apr. 1965 436 p refs
(Grants NsG-496; NIH-MH-04737-04; NSF GP-2495; NIH-GK-57; Contract DA-36-039-AMC-03200(E))
(NASA-CR-64294; AD-615324) CFSTI: HC $7.36/MF $2.25 CSCL 20

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